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Volume 18, Number 20, October 31, 1964

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NUCLEAR SCIENCE ABSTRACTS

BIOLOGY AND MEDICINE

General

Refer also to abstract 35678.

35260 (AERE-PR/HPM-5) HEALTH PHYSICS AND MEDICAL DIVISION PROGRESS REPORT, JANUARY–DECEMBER 1963. (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Mar. 1964. 31p.

Progress is reported on: efficiency of membrane filters; deposition of particles on surfaces from air streams; behavior of aerosols in condensing steam, and atmospheric physics; water droplets; physical chemistry of iodine at low concentrations; neutron dosimetry; photographic dosimetry; operational techniques in radiation measurement; radiation spectrometry; fallout measurement; biological half lives following accidental intakes; oral administration of ^{132}Cs and ^{134}Cs; fallout in human feces; fallout in vivo; radioactivity in infants and children; retention of ^{85}Sr; measurement of ^{239}Pu in vivo; selection of materials for low-background shields; nature and stability of counter background; health chemistry; monitoring beta contamination; radiography; and clinical pathology. A list of papers released during 1963 is included. (H.M.G.)

35261 (NASA-SP-7011) AEROSPACE MEDICINE AND BIOLOGY. A CONTINUING BIBLIOGRAPHY. (National Aeronautics and Space Administration, Washington, D. C.). July 1964. 291p.

Annotated references are presented to approximately 1000 unclassified report and journal articles in the field of aerospace medicine and biology introduced into the NASA information system during the period Jan. 1 to Mar. 31, 1964. Subject, author, and corporate source indexes are included. (C.H.)

35262 (TID-20914) STUDIES ON MECHANISMS OF MUTATION, RECOMBINATION, AND GENE ACTION IN NEUROSPORA. Progress Report, July 1, 1963–June 30, 1964. (Yale Univ., New Haven). Contract AT(30-1)-3098. 11p.

Progress is reported in studies on the effects of various physical and chemical mutagens in producing both forward and reverse mutations at selected specific loci in Neurospora. The mechanisms of mutation, recombination, and gene action are discussed. A list is included of publications during the period covered by this report. (C.H.)

35263 (UCLA-12-529) SEMIANNUAL PROGRESS REPORT FOR THE PERIOD ENDING JUNE 30, 1964. (California. Univ.. Los Angeles. School of Medicine. Lab. of Nuclear Medicine and Radiation Biology). Contract AT(04-1)-Gen-12. 74p.

Separate abstracts were prepared for six sections of this report. A list is included of publications and reports from January through June 1964. (C.H.)

For abstracts of individual sections see: 35264, 35265, 35266, 35267, 35772, and 35812.

35264 (UCLA-12-529(p.15-21)) BIOCHEMISTRY. (California. Univ., Los Angeles. School of Medicine. Lab. of Nuclear Medicine and Radiation Biology).

Data are presented from studies on the composition of brain lipids of young subjects, the radiation chemistry of potassium oleate, and the ultrastructure of beating heart cells in tissue culture. (C.H.)

35265 (UCLA-12-529(p.23-40)) RADIOBIOLOGY. (California. Univ., Los Angeles. School of Medicine. Lab. of Nuclear Medicine and Radiation Biology).

Data are presented from studies on the radiation chemistry of dilute aqueous solutions of papain, the radiation chemistry of aqueous alkaline solutions of pyrimidine compounds, free radical production in water, the radiation chemistry of aqueous solutions of cysteine, the radiosensitivity of activity of biologically active DNA, electron microscopic observations on developing ovian oocytes, the effects of estrogens on proteins and lipids in chicken liver, tracer studies on metabolism in erythrocytes of embryos and young chicks, the synthesis of DNA and RNA in kinetosomes during regeneration of oral structures in the protozoa Stentor, RNA systhesis in amoebae, mitochondrial respiration, the effects of x radiation and plasma concentration on the uptake of ^{65}Zn by rat erythrocytes, and the biological effects of stress on recovery from acute radiation sickness in rats. (C.H.)

35266 (UCLA-12-529(p.41-7)) PHARMACOLOGY AND TOXICOLOGY. (California. Univ., Los Angeles. School of Medicine. Lab. of Nuclear Medicine and Radiation Biology).

Progress is reported in studies on the pharmacological and toxicological properties of $LuCl_3$, $NdCl_3$, and $PrCl_3$; the effects of 650-R x radiation on corticosterone levels in the plasma and adrenal glands of rats; the effects of acetylcholine on contractions of goldfish intestine; the effects of AET on intestinal function in x-irradiated rats; and histological changes induced in rat femur by β particles from implanted Au-plated ^{90}Sr beads. (C.H.)

35267 (UCLA-12-529(p.49-62)) NUCLEAR MEDICINE. (California. Univ., Los Angeles. School of Medicine. Lab. of Nuclear Medicine and Radiation Biology).

The visualization of animal and human lungs, brain, liver, spleen, and other organs by photoscanning after the intravenous injection of microaggregates of high-specific-activity ^{131}I-serum albumin is described. Human lungs were made distinctly visible following the injection of 200 to 300 μc of aggregates of human serum albumin. Applications in the diagnosis of obstructive lesions of the pulmonary arteries and other lung lesions are discussed. Preliminary studies in rabbits and dogs indicate diagnostic usefulness in other organs. Results are reported from measurements of ^{47}Ca absorption in normal individuals and patients with various diseases. Calcium transfer across the placenta was measured in pregnant rhesus monkeys after intravenous injection of ^{47}Ca to the mother and ^{45}Ca into a fetal umbilical vessel. Results are included from studies of the development of leukemia in lethally-irradiated mice protected with cells from mice of a high-incidence leukemia strain, the effect of the thymus and desoxyribonucleic acid from normal and leukemia lymphoid tissue on the incidence of leukemia in hybrid mice, and the effects of leukemic tissue homogenates on the incidence of radioinduced leukemia in mice. Pretreatment of mice with AET before exposure to γ radiation increased the life span provided the total dose did not exceed 1050 R. At doses above 1200 R the protective effect was greatly reduced. (C.H.)

35268 (UR-656) ON THE POSSIBLE ROLE OF CRYSTALS IN THE ORIGIN OF LIFE. William F. Neuman and Margaret W. Neuman (Rochester, N. Y. Univ. Atomic Energy Project). July 29, 1964. Contract W-7401-eng-49. 46p.

It is postulated that two crystalline lattices, the silicates and the apatites, have the properties of surface adsorption and surface catalysis which may have permitted them to play an important role in the origin of life on earth. In particular, they might concentrate monomers of biological interest, amino acids and nucleosides, and catalyzed dehydration reactions leading to phosphorylations and polymer-formation. It was shown that apatite adsorbs a wide variety of monomers. Further, apatite was shown to function as a crude kind of chlorophyll converting radiant energy, heat or infra red irradiation, to high energy phosphate bonds in good yield. Adenosine was shown to be phosphorylated in the 5 position to AMP and the process could be continued to the production of biologically active ATP. Chromatographic evidence was obtained which strongly suggests that oligonucleotides were also produced. The significance of the results is discussed. (auth)

35269 (JPRS-25464) TRANSLATIONS FROM BYULLETEN EKSPERIMENTAL'NOI BIOLOGII I MEDITSINY (BULLETIN OF EXPERIMENTAL BIOLOGY AND MEDICINE), NO. 3, 1964. Translated from Byul. Eksperim. Biol. i Med., 57: No. 3, 59-61; 67-70; 82-5(1964). 48p. (TT-64-31736)

Separate abstracts were prepared for three articles. Other articles discuss the function of cutaneous thermoreceptors in man, premitotic DNA reduplication in animal cells, and a method for recording electrical resistance in pulmonary tissues in man. (C.H.)

For abstracts of individual papers see: 35283, 35325, and 35326.

35270 ATOMSTRAHLUNG IN MEDIZIN UND TECHNIK. ZWEITE WISSENSCHAFTLICH-TECHNISCHE TAGUNG DES DEUTSCHEN ATOMFORUMS e.V., BONN. (Atomic Radiation in Medicine and Industry. Second Science Technology Session of the German Atomic Forum, Bonn.). Munich, Verlag Karl Thiemig KG, 1964. 402p. (CONF-47)

The 55 papers presented at the Second Science Technology Session are compiled. Abstracts of 27 papers were prepared. Six papers were abstracted previously in NSA as: 17: 27618, 29010, 29126, 37041; 18: 1524, and 2101. (J.S.R.)

For abstracts of individual papers see: 35297, 35404, 35431, 35432, 35488, 35572, 35635, 35636, 35637, 35638, 35650, 35681, 35797, 35798, 35799, 35909, 35910, 35911, 35912, 35913, 35917, 35918, 35919, 36170, 36565, 36853, and 36854.

35271 STUDIES OF α RADIOACTIVITY IN RELATION TO MAN. C. R. Hill, R. V. Osborne, and W. V. Mayneord (Royal Cancer Hospital, Surrey, Eng.). p.395-405 of "The Natural Radiation Environment." Chicago, University of Chicago Press, 1964.

Total α counting and spectroscopic techniques that were developed for studying natural α radioactivity in man are described. Some results are given to illustrate the techniques. It was found that ^{210}Po appears to be responsible for dose rates of several mrem/yr in normal human tissues. (D.L.C.)

35272 SOME PROPERTIES OF THE DNA OF THE BACTERIOPHAGE ALPHA. Shirley Ann Morton Cordes. Thesis, Waltham, Mass., Brandeis Univ., 1963. 125p.

The following properties of native Alpha DNA were observed. The DNA contains 22% guanine, 22% cytosine, 29% adenine, and 27% thymine by perchloric acid hydrolysis, which results in a slight thymine loss. No unusual bases or sugars were detected. The T_m for thermal denaturation in SSC and the buoyant density in the cesium chloride gradient have the values expected for a DNA of the base composition found. X-ray diffraction of the DNA fibers at 75% humidity reveals the A form common to most DNAs studied. Electron micrographs show that much of the molecule possesses the 20 Å diameter associated with the Watson-Crick structure. The intrinsic viscosity and sedimentation coefficient in SSC indicate the molecules are highly polymerized and homologous in structure to other DNAs. Native molecules do not show formaldehyde addition measured spectrophotometrically. They do show a limited atypical reaction with antibodies to denatured DNA specific for thymine runs. These properties of the native DNA indicate a normal Watson-Crick structure with the reservation that small single-stranded areas rich in thymine, which would not show formaldehyde addition and would react with the antibodies, might be present. When Alpha DNA is denatured thermally or in 95% formamide it forms two bands, equal in amount, in the cesium chloride gradient. The time course of their formation indicates that they reflect the separation of the strands. These strands have been separated on a methylated albumin column. The base compositions of the strands are roughly complementary to one another. Neither strand can renature alone as measured by increase in hypochromicity or decrease in buoyant density in the cesium chloride gradient. When they are mixed a rapid renaturation is observed. It is concluded that there is a compositional bias between the complementary strands of the Alpha DNA helix which permits their experimental fractionation. Experimental means of detecting possible small single-stranded areas in the native structure are suggested. (A.G.W.)

Ecology

Refer also to abstract 35306.

35273 (TID-3910(Suppl.2)) TERRESTRIAL AND FRESHWATER RADIOECOLOGY. A Selected Bibliography

(Supplement 2). Alfred W. Klement, Jr. and Vincent Schultz (Division of Biology and Medicine, AEC). Mar. 1964. 125p.

A list is presented of 1280 references to the literature on terrestrial and fresh water radioecology. Emphasis is placed on publications issued since Feb. 1963. (C.H.)

35274 ALPHA-RADIOACTIVITY OF PLANKTON. R. D. Cherry (Univ. of Cape Town). Nature, 203: 139-43 (July 11, 1964).

Total alpha activity and thorium-series pair measurements were made on samples of phytoplankton and zooplankton. None of the phytoplankton samples exhibited any time-dependence in the α activity within the limits of statistical error. Recent zooplankton samples showed slight decreases (up to 25%) when recounted two to three months after the original count. With one exception, the zooplankton samples did not exhibit time-dependence over a period of about six months. None of the samples exhibited a rise in α activity with time, apart from the small rise due to radon build-up sometimes observed if the samples were counted too soon. Pair rate statistics were too poor to permit serious conclusions on variations with time. Results indicate that fresh plankton in general contains upwards of 4 pC of α activity/g dried sample. Dose contributions and nuclide concentrations of polonium-210, the thorium series isotopes, uranium, and radium are discussed. (H.M.G.)

Metabolism, Tissue Distribution, and Toxicology

Refer also to abstract 35770.

35275 (LADC-5996) WHOLE-BODY RETENTION OF STRONTIUM^{85} BY NORMAL AND TETRACYCLINE-TREATED MICE. C. R. Richmond and G. A. Trafton (Los Alamos Scientific Lab., N. Mex.). [1963]. Contract [W-7405-eng-36]. 13p.

Oral ingestion of tetracycline at daily doses of 10 mg per kg appeared to affect skeletal deposition but not skeletal turnover of ^{85}Sr. The effect was related to the time when treatment was initiated. Use of whole-body radioassay techniques permit study of skeletal Sr metabolism in the entire live animal. (auth)

35276 (TID-7678(p.19-53)) COMPUTER APPLICATIONS TO THE EVALUATION OF DYNAMIC BIOLOGICAL PROCESSES. Eugene Ackerman and Jane B. Hazelrig (Mayo Clinic, Rochester, Minn.).

Computer techniques suitable for the interpretation of data from kinetic studies using radioisotopes for the evaluation of dynamic biological processes are discussed. The nature of the problems of fitting a model to experimental data and of determining the utility of such models is emphasized by a detailed discussion of a mathematical model for the glucose-insulin control system. It was shown that equations could be easily derived which predict that, following a large oral dose of glucose, the blood-glucose level should follow a damped sine wave. A special iterative systematized guessing technique was developed to test this. The success of this curve fitting implies that additional studies are worth pursuing to determine the limitations of this model and hopefully to eventually replace it with a less simplified one. The iterative systematized guessing technique is a simple, straightforward method, free from most of the defects of other, more elaborate types of analysis. Its use depends upon the availability of a digital computer. It is pointed out that the types and ranges of problems to which it can be applied include almost every area in which dynamic processes are studied in biology and medicine. 15 references. (C.H.)

35277 (TID-7678(p.55-79)) BASIC ASPECTS OF KINETIC THEORY AS APPLIED TO TRACER-DISTRIBUTION STUDIES. Kenneth L. Zierler (Johns Hopkins Univ., Baltimore. Hospital).

General equations are presented that pertain to the distribution of radioactive tracers in the body after introduction by inhalation, by ingestion, by intravascular injection, or by injection into some extravascular site to provide a quantitative estimate of some bodily function. The equations can be used to derive data on the flow through the system, or turnover rate, of the injected radioisotope and in calculations of the volume of the system, derived by multiplying the flow times by the mean transit time of the concentration curve. Mathematical methods for data treatment to simplify the calculation procedures are discussed. Application of the kinetic theory in tracer distribution studies are illustrated by examples and mathematical models are included for data analysis of the selected examples. These include the calculation of blood, plasma, or red blood cell flow; the calculation of fractional loss from capillaries; and the calculation of metabolic or of sequestration rates. (11 references.) (C.H.)

35278 (TID-7678(p.445-72)) THE PLASMA ALBUMIN SYSTEM. A FIRST ATTEMPT AT A KINETIC DESCRIPTION. E. B. Reeve (Colorado. Univ., Denver. Medical Center).

Progress in the use of radioactive isotopes for the study of plasma protein metabolism is briefly reviewed. It is pointed out that studies of plasma protein metabolism and distribution in the unsteady state with isotopes require either methods with which the essential measurements can be made in a brief period or sufficient knowledge of how the physiological variables behave to allow clear-cut interpretation of tracer data. A plasma protein system is defined, and a brief examination of current knowledge of the plasma albumin system is made. A simple kinetic description of the plasma albumin system in man is developed, based on the above analysis, on ^{131}I–albumin studies in healthy men, on albumin catabolic rates and urinary losses of albumin in patients with the nephrotic syndrome, and on the effects of daily infusions of albumin intravenously. This kinetic description implies that the liver synthesizes albumin at a variable synthetic rate, regulated by a feedback mechanism dependent on the level of plasma albumin, and that infusion of albumin leads to accelerated passage of albumin to catabolic sites and to the interstitial fluids. The equations of this system match quite closely a single series of observations on man. Some of the deficiencies of the kinetic description are noted. However, it does describe a stable system that after a perturbation returns to its initial state, and it does point to the experiments required to provide the knowledge to remedy its present deficiencies. 69 references. (C.H.)

35279 (TID-7678(p.497-518)) TURNOVER OF VITAMIN B_{12} IN MAN. R. M. Heyssel, R. C. Bozian, and W. J. Darby (Vanderbilt Univ., Nashville. School of Medicine).

Results of studies of the fate of injected ^{60}Co-labeled vitamin B_{12} showed that in normal individuals absorption of vitamin B_{12} from dietary sources of quantitatively similar to absorption of crystalline B_{12} and is remarkably efficient at low levels of intake. A lower limit of absorption of at least 2 micrograms of B_{12} daily on the usual American diet would appear reasonable. The data available do not allow estimates of the upper limit of daily absorption from food,

but it is undoubtedly higher than 2 micrograms. There is a block in B_{12} absorption from food from a given feeding at a 2- to 3-microgram level. There is evidence for a number of body pools or compartments of B_{12}. The largest single one of these is the storage compartment and evidence indicates that tracer doses achieve relative equilibrium within these compartments over a long period of time, of the order of 60 to 120 days. Obligatory losses of B_{12} from the body occur as a first-order function irrespective of size of body stores at a rate of about 0.1%/day. In normal adults these losses approximate 2 to 5 micrograms of B_{12} per day. These amounts are in accord with maintenance of a steady state with regard to body B_{12} stores based on absorption studies. On clinical grounds a maintenance dose of approximately 1 microgram of B_{12} per day is adequate for most patients with pernicious anemia. The question of the necessity of attempting to normalize body stores or serum levels in B_{12}-depleted patients with large doses of B_{12} cannot be answered from kinetic studies such as are described. There is no present support, however, for the thesis that large body stores are associated with an enhanced state of health, and indeed they are associated with increased loss of the vitamin. 42 references. (C.H.)

35280 (TID-7678(p.581-606)) COPPER METABOLISM AND WILSON'S DISEASE. Charles A. Owen, Jr. (Mayo Clinic, Rochester, Minn.).

Problems involved in the diagnosis of Wilson's disease, or hepatolenticular degeneration, are reviewed. Results are reported from studies in rats, using ^{64}Cu as a tracer, that help to establish the etiology of this disease. The uptake of copper by the isolated rat liver and the subsequent synthesis of ceruloplasmin appeared to be the same as these functions in an intact rat. There was a limit to the amount of copper that could be taken up by the liver in any period of time. The greater the amount of copper added to blood, the longer the time required by the liver to clear the blood. The copper extracted from the blood by the liver was in part rapidly excreted into bile, in part returned more slowly to the blood as ceruloplasmin, and in part deposited in the erythrocytes. The amount of copper excreted in the bile per unit of time seemed to be related to the concentration of ionic copper in the blood during that unit of time. This afforded an indirect method for estimating intestinal absorption of copper in a rat with a biliary fistula. The isolated rat liver appeared to synthesize ceruloplasmin efficiently in the absence of preexisting ceruloplasmin in the plasma. Further, the addition of excessive ceruloplasmin to the perfusing blood did not increase the synthesis of new ceruloplasmin. There was no evidence that the liver itself catabolized significant amounts of ceruloplasmin within the 5-hr period of hepatic perfusions. There appeared to be a very slow buildup of radiocopper in rat tissues long after the injected ionic copper had practically disappeared and at a time when the ceruloplasminic ^{64}Cu was diminishing in the blood. A theory is proposed that the liver attempts to rid the body of excess ionic copper by biliary, urinary, and intestinal excretion and to transport needed copper to the tissues in the form of ceruloplasmin. This theory was extended to account for the deranged metabolism of copper that exists in Wilson's disease. 57 references. (C.H.)

35281 (TID-20915) ANNUAL PROGRESS REPORT [ON ENZYMATIC SYNTHESIS OF POLYADENYLATES AND CONTROL OF DNA SYNTHESIS IN MAMMALIAN CELLS], JULY 15, 1964. Richard Abrams (Montefiore Hospital, Pittsburgh). Contract AT(30-1)-1818. 16p.

Progress is reported in studies on the roles of RNA and protein synthesis in the subsequent synthesis of DNA in intact mammalian cells and the nature of the primers needed for homopolymer synthesis with enzymes from calf thymus nuclei. Data are included on the purification of ATP polymerase and the control of DNA synthesis in rabbit kidney cells in culture, L cells, and Escherichia coli. (C.H.)

35282 (AEC-tr-6447) ACCUMULATION OF RADIOACTIVE STRONTIUM BY FRESH-WATER PLANTS. V. B. Chumichev. Translated from a Russian Report, State Committee on the Peaceful Uses of Atomic Energy, SSSR, Moscow, 1963. 5p.

The role of water plants in the removal of fallout fission products from water in reservoirs is discussed. Results are presented from a study of the accumulation of ^{90}Sr by fresh-water plants growing in a river between June and September. Results indicate that ^{90}Sr enters plants from the atmosphere as well as from the water and that a substantial part of the ^{90}Sr accumulated by the plants entered directly from the atmosphere. (C.H.)

35283 (JPRS-25464(p.14-21)) Sr^{90} AND Ca^{45} PASSAGE THROUGH THE PLACENTA OF RATS. Yu. D. Parfenov and A. A. Yusupov. Translated from Byul. Eksperim. Biol. i Med., 57: 67-70(1964).

A dual tracer technique was used to determine the extent of discrimination against the placental passage of Sr in favor of Ca in pregnant rats when the elements were supplied to the maternal organism prior to the inception of pregnancy. Results showed that in the case of intraperitoneal injection of ^{90}Sr and ^{45}Ca in the maternal organism and their intake by progeny through the placenta during pregnancy, discrimination against Sr in favor of Ca resulted. The data show the comparative deposition of these isotopes and the degree of discrimination between Sr and Ca during pregnancy. The $^{90}Sr/^{45}Ca$ in newborn rats was 0.54 ± 0.07 of the $^{90}Sr/^{45}Ca$ ratio which occurred during injection into the intraperitoneal cavity. On the basis of this index, it was concluded that during pregnancy Ca in rats exceeds Sr almost two fold in the ability to pass through the placenta from the maternal organism and to accumulate in the developing embryos. The same observed ratio of $^{90}Sr/^{45}Ca$ was also obtained for the developing cranial bone of a baby rat. The data are compared with data on the deposition of ^{90}Sr and ^{45}Ca in the maternal skeleton. (C.H.)

35284 A METHOD FOR CONTINUOUS MONITORING OF THE RAPID UPTAKE OF IONS BY BIOLOGICAL TISSUES. B. Danielson and U. Sjoestrand (Uppsala Univ.). Acta Physiol. Scand., 59: 349-56(1963).

A method is described with which the uptake of ions by biological tissues can be studied continuously. The method makes possible studies during short time intervals (0.1 sec). The preparation is mounted in a chamber which is inserted in a γ-ray analyzer. Through the chamber is flushed Ringer's solution interrupted by periods of silicone oil. The silicone oil is inert to the system. The preparation used was the sinus venosus of the frog's heart. Influx curves for ^{42}K and ^{24}Na are presented. (Excerpta Med. Sect. 23, 1: No. 7, July 1964)

35285 INCORPORATION OF RADIOACTIVE THYMIDINE INTO MAMMALIAN CELLS CULTIVATED IN VITRO. A. Girgis and J. Vieuchange (CNRS, Paris). Ann. Inst. Pasteur, 106: 29-47(1964).

The incorporation of ^{3}H and ^{14}C thymidine into mammalian cells cultivated in vitro as a function of time was studied autoradiographically and by liquid scintillation counting

technique. At the beginning this incorporation occurred exclusively in the nuclear material. After a specific time for each type of cells, the radioactivity appeared in the cytoplasm. Cytoplasmic labeling and its significance are discussed. With thymidine-2-^{14}C, only the nuclear material seems to be labeled. Mammalian cells, after incubation, in presence of ^{3}H thymidine or ^{14}C thymidine, were treated with N hydrochloric acid at 60°C. The retention of the radioactive material in cells as a function of hydrolysis time was studied autoradiographically and by liquid scintillation counting technique. Even after 110 min of hydrolysis a significant retention of the radioactivity material was observed in the cells. (Excerpta Med., Sect. 23, 1: No. 7 (July 1964))

35286 DETERMINATION OF THE LYMPH NODE RADIOACTIVITY ON ENDOLYMPHATIC INFUSIONS OF I^{131}. P. Grella and S. Bresadola (Universitâ, Padua). Attualita Ostet. Ginecol., 9: 761-8(1963).

An account is given of a method for the determination of the therapeutic dose of ^{131}I in lymphadenoma therapy. The infusion of 7 mc makes it possible in the first two weeks to reach an average dose of 9,253 rads in the lymph nodes. A study is made of the distribution of the radioactivity in separate lymphatic stations in relation to dose, time, and technique of infusion. (Excerpta Med., Sect. 23, 1: No. 7, July 1964)

35287 THE EFFECT OF PARATHORMONE ON THE FIXATION OF THE RADIOACTIVE CERIUM IN THE BONE TISSUE. T. Trnovec, M. Beňo, V. Zbořil, A. Pleškova, V. Rusek, and F. Minárik. Bratislav. Lekarske Listy, 44: 24-9(1964).

The effect of the induction by parathormone of resorption processes in the bone tissue on the capacity of the bone tissue to bind radioactive cerium, representing one of the radioisotopes of rare-earth elements, was studied on rats. Following an intravenous injection of cerium 144 the activity of the organs and the concentration of radioactive cerium were measured in the diaphysis of the femurs and in the skeleton. In the bone tissue of the control group there was established, partly, a statistically significant higher radioactive cerium concentration. The theory presuming a relationship between the processes of resorption and the fixation of radioactive isotopes of rare-earth elements, which could not be proved in a previous experiment with vitamin A, could thus be verified. (Excerpta Med., Sect. 23, 1: No. 7, July 1964)

35288 ZIRCONIUM CITRATE REDUCES Sr^{90} BODY BURDEN. Gloria E. Zander-Principati and Joseph F. Kuzma (Marquette Univ., Milwaukee). Health Phys., 10: 473-7(July 1964).

Mice injected with cancerogenic doses of ^{90}Sr were treated with zirconium citrate, or zirconium citrate and the diuretic, Diamox. External body measurements of radiation at 10 and 12 months after ^{90}Sr injection were made from the intact animal by positioning a thin-walled Geiger tube over the dorsal surface of the mouse. Statistical comparisons of the mean count rates in treated and untreated groups showed that zirconium citrate reduced the body burden of ^{90}Sr by approximately one-third at all ^{90}Sr dose levels tested. Addition of Diamox did not improve results. (auth)

35289 EXPERIMENTS WITH AND RESULTS OF THE DETERMINATION OF THE POLONIUM^{210} CONTENT IN THE URINE OF SUBJECTS EXPOSED AND NOT EXPOSED TO Rn^{222}. Tibor Zsoldos and Arpad Toth (Ore Mining Co. of Mecsek, Pecs, Hungary). Kiserl. Orvostud., 16: 302-9 (June 1964).

The determination of ^{210}Po from the urine by means of spontaneous deposition is discussed. The dependence of the method on the time of deposition, temperature, and on the ^{210}Po content of the solution was established. A mathematical derivation is given of the yield factor and of the lower limit of sensitivity of the method. The reproducibility of the degree of effectiveness of counting, the stability of the geometry, and the stability of the background and of the degree of effectiveness were examined from a measurement technical point of view and the future directions of the research are discussed. The expected ^{210}Po content of a person exposed to a normal radon is mentioned. (OTS)

35290 STRONTIUM-90 METABOLISM DURING LOW STRONTIUM-90 INTAKE IN MAN. Herta Spencer-Laszlo (Veterans Administration Hospital, Hines, Ill.), Joseph Samachson, Edward P. Hardy, Jr., and Joseph Rivera. Radiation Res., 22: 668-76(Aug. 1964).

Metabolic balances of ^{90}Sr and calcium were determined in ten young healthy volunteers under controlled dietary conditions during a low calcium-low ^{90}Sr intake. No radioisotope was administered during the study. The average dietary ^{90}Sr intake was 3.1 μμc/day. The major portion of ingested ^{90}Sr passed through the intestine, and the fecal ^{90}Sr excretion corresponded to 85% of the ^{90}Sr intake. The net absorption of ^{90}Sr was lower than that of calcium; the average Ca/average ^{90}Sr net absorption ratio was 1.7. The urinary ^{90}Sr excretion was 13% of the ingested ^{90}Sr; the average ^{90}Sr balance was 0.1 ± 0.3 μμc/day. The contribution of the previous ^{90}Sr intake to the urinary and endogenous fecal ^{90}Sr excretion was determined, and the true ^{90}Sr absorption was calculated to be 21% of the ^{90}Sr intake. No major differences were noted in the percent absorption and excretion of ^{90}Sr for subjects receiving a low calcium diet (without milk) having a ^{90}Sr/Ca ratio of 19 μμc/gm Ca and subjects previously studied on the same diets to which milk was added, having a ^{90}Sr/Ca ratio of 11 μμc/gm Ca. However, the percent absorption and excretion of calcium differed on the two dietary intake levels. (auth)

35291 STRONTIUM-90 BALANCES DURING STARVATION IN MAN. Herta Spencer-Laszlo (Veterans Administration Hospital, Hines, Ill.), Joseph Samachson, Edward P. Hardy, Jr., and Joseph Rivera. Radiation Res., 22: 677-81 (Aug. 1964).

Strontium-90 and calcium balance studies were carried out during starvation in three volunteers under controlled metabolic conditions. The ^{90}Sr intake during the study averaged 0.59 μμc/day, and the calcium intake averaged 96 mg/day. The urinary excretion of ^{90}Sr and calcium was markedly higher during starvation than during the preceding control period, most probably because of the induced metabolic acidosis. The daily urinary excretions of both ^{90}Sr and calcium were greater than the daily intake of these two elements. The fecal excretion of ^{90}Sr was greater than the ^{90}Sr intake, while the fecal calcium excretion was about equal to the calcium intake during the period of starvation. The average ^{90}Sr balance was −1.1 μμc/day during starvation, compared to an average balance of +0.1 μμc/day during the low ^{90}Sr control study. The average calcium balance was −183 mg/day during starvation, compared to −56 mg/day during the low calcium control study. (auth)

35292 THE TECHNIQUE OF MICROELECTRONIC AUTOCYTORADIOGRAPHY WITH P^{32} AND I^{131}. I. Petrea and O. Stătescu (Inst. of Endocrinology, Bucharest). Rev. Sci. Med., Acad. Rep. Populaire Roumaine, 8: 135-40 (1963).

After modifying some technical details, the microelec-

tronic autocytoradiographic method was used to study the incorporation and transfer of ^{32}P and ^{131}I in certain endocrine organs and glands. The presence of radiating substances is detected by the black precipitates of silver crystals either alone or more often disposed in polymorphic conglomerations, which appear at the surface of the section after the development of the nuclear emulsion. The numerous control series studied show the fine ultragranulation of the silver particles contained in the nuclear emulsion used. (Excerpta Med., Sect. 23, 1: No. 7, July 1964)

35293 PASSAGE OF BLOOD-BRAIN BARRIER BY P^{32} DURING THE ACUTE STAGE OF CLOSED CEREBROCRANIAL TRAUMA. R. Chenkov and T. Stoyanchev. Voenno Med. Delo, 19: 43-8(1964).

Data are given on the permeability of the blood-brain barrier to ^{32}P in 8 patients with cerebral concussion and 10 with cerebral contusion. In the concussion cases, passage of orally administered ^{32}P into cerebrospinal fluid was from 0 in two patients to 2.5% in two; in the ten cases with contusion, it ranged from 0 in one to 10 (only patient receiving ^{32}P intermuscularly), 25 and 34% each in one patient; averaging 8.31%. One very detailed case history is given. (OTS)

35294 INHALATION STUDY WITH RADIOACTIVE CALCIUM (Ca^{45}) IN GUINEA PIGS. W. Schiessle, I. Schmidtke, K. Philipp, and E. Schroff (Universität, Freiburg i. B.). Zentr. Biol. Aerosol Forsch., 11: 373-96 (Feb. 1964). (In German)

The uptake, distribution, and elimination of ^{45}Ca were investigated for 28 days in 112 guinea pigs that had inhaled $^{45}CaCl_2$ with various inactive carrier additions for 30 min. In the entire respiratory tract, Ca was resorbed well. Before the termination of the inhalation time, the maximum of the transpulmonary resorption was attained as indicated by activity in the blood and the extrapulmonary and extradigestive organs. A significant fraction of the dissolved Ca was absorbed in the lungs from the lymph system. Considerable ^{45}Ca concentrations in the lymph tissue 24 hrs after inhalation indicated that calcium possesses lymphotropic properties. Abundant ^{45}Ca was also found in the mediastinal glands. A cycle existed through secretion and back resorption. The bronchogenic defibrillation, because of the good resorption ratios, had no great significance. It is known that calcium excites ciliary epithelium. Approximately half the incorporated ^{45}Ca dose was found shortly after the end of the inhalation in the gastrointestinal tract and was resorbed from there in high percentages. After a primary hemodynamic distribution of the pulmonary and intestinal resorbed calcium in the total organism, a rapid and intensive enrichment occurred in the skeletal system and attained a maximum value within 4 weeks. After 4 weeks the ^{45}Ca concentration in the bones was 97.5% of the retained dose. The bones were also the organ with the highest radiation damage. As the quantitative determination of the elimination of the inhaled or incorporated Ca showed, only 22% was eliminated during the 4 weeks. The high calcium retention was conditioned by introduction in the bones. Inhalation studies with low carrier additions showed a high lung retention in comparison to investigations with high carrier additions. The calcium introduced to the guinea pigs by inhalation of the lowest carrier concentration was in the same order of magnitude as the calcium uptake with the respiratory air. Inhalation investigations with radioactive indicators without noteworthy carrier addition are well suited as a model for the study of the trace matter introduced in the lungs and total organism. (tr-auth)

35295 INHALATION STUDY WITH RADIOACTIVE ZIRCONIUM WITH AND WITHOUT CARRIER ADDITIVE IN GUINEA PIGS. I. Schmidtke, W. Schiessle, and K. Philipp (Universität, Freiburg i. B.). [Zentr. Biol. Aerosol Forsch., 11: 397-419(Feb. 1964)]. (In German)

The uptake, resorption, distribution, and elimination of inhaled radioactive Zr with and without carrier additives were studied in guinea pigs. The results after carrier-free ^{95}Zr inhalation correspond with earlier inhalation studies. In spite of the low solubility of Zr in the body milieu, a relatively high percentage was resorbed and was deposited to a large extent in the bones. The elimination occurred principally through the intestines. After four weeks, 85% of the incorporated dose was eliminated. The lung retention was still 22% of the initial value after 4 weeks. As histograms showed, ^{95}Zr was enriched in spots in the alveolar septi. The addition of inactive carrier did not alter the distribution pattern in the total organism and still less was the extent of the renal elimination of the Zr circulating in the blood altered. A displacement of the inhaled particles occurred in the direction of the cranial section. The lung clearance in the first days was slower than after inhalation of carrier-free Zr. After 4 weeks the ^{95}Zr concentration in the lungs was still 42% of the initial value. (tr-auth)

35296 INFLUENCE OF THE PRECIPITATION OF INHALED YTTRIUM-91 BY DIETHYLENETRIAMINEPENTA ACETIC ACID (DTPA). I. Schmidtke (Universität, Freiburg i. B.). [Zentr. Biol. Aerosol Forsch., 11: 432-9(Feb. 1964)]. (In German)

The effect of diethylenetriaminepentaacetic acid (DTPA) on the elimination and the distribution pattern of inhaled ^{91}Y was investigated in guinea pigs. DTPA was injected subcutaneously immediately after the conclusion of the radioactive exposure by inhalation and then once daily. The observation time lasted from 1 hr to 8 days after the ^{91}Y inhalation. The results obtained on the animals killed after 8 days and the elimination values are reported. It was shown that DTPA in this treatment plan increased the elimination of inhaled ^{91}Y almost 20 times in comparison with the control animals. In opposition to the elimination usually occurring preponderantly by the feces, the renal elimination was shown to be increased. The ^{91}Y concentration in the different tissues was extremely depressed; the deposition after 8 days in the lungs was only 2.01%, in the liver 1.56%, and in the skeleton 2.76% of the control value. (tr-auth)

35297 USE OF RADIOISOTOPES IN EXPERIMENTAL TUBERCULOSIS STUDIES. J. Meissner. p.74-82 of "Atomstrahlung in Medizin und Technik." Munich, Verlag Karl Thiemig KG, 1964. (In German)

Experimental tuberculosis research using radioisotopes is reviewed. The reaction of the host organism to the tuberculosis infection was illustrated by studies of the DNA specific activity in rabbits, using ^{32}P as the labeling isotope. The detection of the interaction of the host with the germ was shown in animal research using labeled tubercular germs. Investigations on immunity problems were then summarized. (J.S.R.)

35298 PREPARATION OF RADIOACTIVE Co ENZYME A AND STUDIES OF THE MECHANISM OF FATTY ACID SYNTHESIS. E. Schweizer. Thesis, Munich, Universität, 1963. 104p. $2.00(Gmelin, AED-DISS. 63-475).

Using the yeast cells Sacch. caresbergensis, 1-^{14}C-pantothene acid was incorporated into Coenzyme A. With this radioactive Coenzyme A the existence of a fatty acid-

transferring enzyme in yeast synthetase was demonstrated. Results indicate that the capability of an acyl-Co A derivate to start fatty acid synthesis decreases with increasing chain length. Possible explanations of this effect are given. A new reaction scheme for fatty acid synthesis is discussed. (Gmelin Inst.)

35299 STRONTIUM SORPTION BY CHLORELLA PYRENOIDOSA IN CONTINUOUS CULTURE. John Henry Austin. Thesis, Berkeley, Calif., Univ. of California, 1963. 191p.

An investigation was undertaken to study some environmental factors as they affect strontium uptake by a member of the first trophic level, the unicellular alga Chlorella pyrenoidosa. Cultures of Chlorella pyrenoidosa were developed under steady-state conditions with calcium and magnesium concentrations ranging over those found in natural waters. The results indicated that the steady-state concentration of strontium activity on the cells of Chlorella pyrenoidosa depended on the ionic composition of the substrate. It was dependent on the concentration of both calcium and magnesium. At magnesium concentrations above several hundred milligrams per liter the strontium and calcium distribution coefficients (the ratio of the sorbable ion in the solid and liquid phase) remained relatively constant. At magnesium concentrations below one hundred milligrams per liter, the strontium and calcium distribution coefficients varied with both calcium and magnesium concentrations. Chlorella pyrenoidosa demonstrated a discrimination against strontium similar to that shown by other organisms at higher trophic levels. This discrimination may be expressed by a "selectivity coefficient" which is the ratio of the strontium to calcium distribution coefficients. The selectivity coefficient remained relatively constant over a wide range of magnesium concentrations and averaged 0.58; a coefficient less than unity indicating discrimination against strontium, i.e., a favorable selectivity for calcium. The sorption of strontium by Chlorella pyrenoidosa varies considerably during various phases of the growth cycle. Thus in natural aquatic systems where environmental conditions vary considerably with time, the estimation of strontium sorption would be difficult, whereas in saline waters, with relatively constant environmental conditions, the prediction of strontium sorption could be made with much more certainty. (Dissertation Abstr., 24: No. 12, Pt. I (June 1964))

35300 THE EFFECT OF CHLOROTHIAZIDE ON CESIUM EXCRETION IN HUMAN SUBJECTS. J. Harrison and K. G. McNeill (Univ. of Toronto). Vienna, International Atomic Energy Agency, 1964, Preprint SM-52/45, 10p. (CONF-448-20)

From IAEA Symposium of the Assessment of Radioactive Body Burdens in Man, Heidelberg, May 1964.

The factors that influence cesium metabolism in normal human subjects were investigated with particular interest in finding a therapeutic regimen for reducing the body burden of cesium. Since cesium and potassium are chemically similar, and are both localized in the intracellular compartment of the body, principally in muscle, it seemed possible that chlorothiazide, which has a marked potassium diuretic effect, might also increase cesium excretion. Four normal subjects were given a single dose of 0.1μc of ^{137}Cs by mouth. Two subjects were given chlorothiazide 2.0 gm/day for a total of 3 consecutive days starting 1 hour after the cesium intake. The chlorothiazide dose was repeated at 2 weeks. The other two subjects were used as controls. The body burden of ^{137}Cs was measured by a whole-body counter at intervals up to 320 days. Daily urine collections were made for 3 control days and 20 days following cesium intake. The samples were analysed for electrolytes and cesium activity. Although chlorothiazide increased K excretion to 1.5 times the control values, it had no significant effect on cesium excretion or in reducing the body burden of cesium. In all subjects a small fraction of Cs (10 to 20%) was excreted rapidly with a biological half-life (T_b) of less than 1 day. The remainder was excreted at a constant rate with T_b of 90 to 155 days. More than 70% of the cesium eliminated from the body per day was excreted by the kidney. Results demonstrate that cesium and potassium are not utilized interchangeably. Cesium is retained preferentially over potassium and changes in potassium turnover have no effect on cesium turnover. (auth)

35301 A NEW TECHNIQUE FOR DETERMINING THE DISTRIBUTION OF RADIUM AND THORIUM IN LIVING PERSONS. C. E. Miller (Argonne National Lab., Ill.). Vienna, International Atomic Energy Agency, 1964, Preprint SM-52/36, 15p. (CONF-448-17)

From IAEA Symposium of the Assessment of Radioactive Body Burdens in Man, Heidelberg, May 1964.

A technique is described for the detection of substantial non-uniformity in distribution of radium in patients who cannot or will not lie still for more than one hour. A newly designed right-cylindrical crystal 15 cm in diameter by 20 cm long is placed 30 cm above the surface of a rigid bed with the axis of the crystal horizontal and at right angles to the supine patient's vertebral column. This log-shaped crystal is used instead of the typical vertical squat cylinder in order that the surface areas and cross sections of the crystal be of the same shape when viewed from any point in the body. The gamma-ray spectra from the supine patient and from point radioactive sources in the center of pressedwood phantoms were obtained with the crystal located at x number of uniformly spaced positions along the bed. The counting rates obtained for selected photopeaks from the spectra of the patient and the phantom were fed into an electronic computer, which is programmed to calculate a series of point sources that would give the same gamma-ray profile. The results with a number of radium patients have demonstrated that, while the distribution is frequently essentially uniform, some persons contain a concentration two or three times higher than the mean in the lower legs, the pelvis, or in the skull. The sums of the calculated sources agree within a few per cent with the total radium body contents measured with other whole-body counting techniques. Measurements made of two patients who received thorotrast about eighteen years ago and of phantoms containing thorotrast and RdTh also demonstrated the feasibility of measuring the nonuniformity of distribution of ^{208}Tl(ThC''), of ^{228}Ac(MsTh^2), and possibly of ^{212}Pb along the axis of the body. (auth)

Radiation Effects

35302 (AD-438540) EFFECTS OF RADIATION ON CELL DIVISION AND CHROMOSOMES IN ANIMALS. Quarterly Report, March 15, 1961—June 14, 1961. Sajiro Makino (Hokkaido Univ., Sapporo, Japan). Contract DA-92-557-FEC-34462. 15p.

Progress is reported in studies on the effects of radiations on cell division and chromosomes in animals. Results are reported from studies on the effects of β particles on cell division in grasshopper spermatocytes, the effects of x radiation on human cells in culture with emphasis on chromosome breaks, the effects of x radia-

tion on spermatogenesis of Drosophila virilis; the effects of γ radiation on the number of micronuclei in Paramecium polycaryum, and the immunological response of lethally irradiated rats to heterologous mouse spleen homogenate injections. A list is included of publications resulting from these studies. (C.H.)

35303 (AD-438541) EFFECTS OF RADIATIONS ON CELL DIVISION AND CHROMOSOMES IN ANIMALS. Quarterly Report, June 15, 1961–September 14, 1961. Sajiro Makino (Hokkaido Univ., Sapporo, Japan). Contract DA92-557-FEC-34462. 11p.

Progress is reported in studies on the effects of radiations on cell division and chromosomes in animals. Results are included from studies on the effects of γ radiation on nuclear division in Paramecium; the effects of doses of x radiation of 100, 300, and 500 R delivered to mice on the 7th, 15th, 25th, 30th, and 50th day of life on reproductive capacity, litter size, incidence of abnormal fetuses, and growth rate; effects of x radiation on chromosome morphology of normal human lung cells in tissue cultures; the effects of ^{198}Au on chromosomes in human gastric tumor cells; the synergistic effects of x radiation and the chemicals, mitomycin, carzinophilin, and thio-TEPA, on the mitotic index, nuclear structure, and chromosome aberrations in rat tumor cells; the immunological response of lethally x irradiated mice to injected rat spleen homogenates; and the effects of localized β irradiation on chromosomes in grasshopper spermatocytes. (C.H.)

35304 (AD-439300) THE EFFECT OF COBALT-60 GAMMA RADIATION ON THE CENTRAL NERVOUS SYSTEM. Semi-annual Report, May 7–November 6, 1963. Akira Tsuya (Yokohama Municipal Univ., Japan). 8p.

The effect of ^{60}Co gamma radiation on the central nervous system was studied electroencephalographically in unanesthetized rabbits. The phenomena of elevated threshold for inducing EEG after reaction was observed as low as 100 r after whole-head single irradiation, and its degree and recovering process was found to be highly dose-dependent. (auth)

35305 (AROD-795) IRRADIATION OF MEAT PROTEIN. Technical Status Report No. 4, January 1–May 1964. Annual Report No. 1, May 1, 1963–May 1, 1964. D. N. Rhodes (Gt. Brit. Low Temperature Research Station. Radiation Group, Cambridge, England). Contract DA/91/591/EUC/2900. 17p. (AD-601588)

Progress is reported in studies on the effects of radiation on the nutritive value of meat proteins. Data are included on the chemical effects of 20 and 40 Mrad γ radiation on poly-L-glutamic acid in solution. (C.H.)

35306 (BNL-7200) EFFECTS OF IONIZING RADIATION ON NATURAL ECOSYSTEMS. G. M. Woodwell (Brookhaven National Lab., Upton, N. Y.). [nd]. Contract [AT(30-2)-Gen-16]. 11p.

The characteristic patterns of natural ecosystems are outlined, and types of changes produced in these patterns by ionizing radiation are discussed. Potential levels of radiation exposure produced by nuclear war are estimated. Data are summarized from studies of radiation effects on natural ecosystems. It is concluded that total radiation exposures in the range of 5,000 to 10,000 R in a six-month period would kill more than 90% of the trees of most deciduous forests, and exposures in the range of 1,000 to 3,000 R would damage coniferous forests similarly, while grasslands, weed fields, and tundra would be substantially more resistant. Coincident with the radiation damage to plants in such systems there would be fluctuations in insect and animal populations. Radiation exposures in the range of 1,000 to 10,000 R are well within the range of exposures from fallout that could be expected from a nuclear attack. (C.H.)

35307 (BNL-7271) THE INFLUENCE OF THE CENTROMERE ON CHROMOSOME FRAGMENT FREQUENCY UNDER CHRONIC IRRADIATION. H. J. Evans and Virginia Pond (Brookhaven National Lab., Upton, N. Y.). [1963]. Contract [AT(30-2)-Gen-16]. 32p.

The influences of dose rate and exposure time on the yields of chromosome fragments and micronuclei were studied in young plants of Vicia faba and Luzula purpurea exposed to chronic gamma irradiation. At sublethal dose rates the frequency of fragments and of micronuclei in Vicia remained constant with increasing exposure time, the ratio of micronuclei to metaphase fragments being 1:5.2. The kinetics of this steady-state situation is discussed. The presence of a diffuse centromere in Luzula resulted in little or no loss of fragments at mitosis. Two of the consequences of the retention of such fragments are the rarity of micronuclei, the ratio of micronuclei to metaphase fragments being 1:518, and the absence of a steady-state situation, the fragment frequency increasing with increasing exposure time. An evaluation of the Luzula data on the distribution of fragments between cells led to the conclusion that cells with relatively high numbers of fragments are selectively eliminated from the meristematic cell population. One of the Luzula plants exposed at 250 R/day for 46 days proved to be a diploid/tetraploid chimera. In this plant the fragment frequency in tetraploid cells was almost exactly twice the frequency found in the diploid cells. (auth)

35308 (BNL-7316) THE EFFECT OF MITOTIC CYCLE DURATION ON CHROMOSOME BREAKAGE IN MERISTEMATIC CELLS OF PISUM SATIVUM. J. Van't Hof and A. H. Sparrow (Brookhaven National Lab., Upton, N. Y.). [1963]. Contract [AT(30-2)-Gen-16]. 17p.

Experiments were performed with seedlings of Pisum sativum to test the hypothesis that radiosensitivity with respect to chromosome damage increases during chronic irradiation with increased mitotic cycle time. Minimum cycle times were determined for root meristem cells. Temperatures of 30, 25, 15, and 10°C were used to obtain different minimum cycle times. The results of chronic γ exposures indicated that the minimum cycle time was not altered in Pisum sativum until the total exposure per cycle exceeded about 440 to 450 r, the percentage of cells showing demaged chromosomes at a stated daily exposure rate increased with decreasing temperatures if mitotic cycle time was not considered, but when the cycle time was taken into account the production of damaged cells was a linear function of the amount of total exposure per mitotic cycle up to the critical value 440 to 450 R/cycle. (auth)

35309 (BNL-8010) THE USE OF NUCLEAR AND CHROMOSOMAL VARIABLES IN DETERMINING AND PREDICTING RADIOSENSITIVITIES. A. H. Sparrow, Rhoda C. Sparrow, K. H. Thompson, and L. A. Schairer (Brookhaven National Lab., Upton, N. Y.). [1964]. Contract AT-30-2-GEN-16. 67p. (CONF-551-2)

From Technical Meeting on the Use of Induced Mutations in Plant Breeding Programs, Rome, May–June 1964.

The radiosensitivities of a number of species of woody and herbaceous plants were determined using growth inhibition and lethality as end points following acute or chronic exposure to x or γ radiation. Nuclear volumes were obtained for apical shoot meristems of the same

species, and interphase chromosome volumes were estimated by dividing these nuclear volumes by the chromosome number characteristic of each species. Data on some 50 plants are tabulated. The relation between DNA per chromosome and radiosensitivity is discussed. A new interpretation is presented of the cause of differences in sensitivity related to changes in ploidy. (54 references.) (C.H.)

35310 (NP-14043) THE EFFECTS OF MASSIVE DOSES OF IONIZING RADIATION UPON CONDITIONED AVOIDANCE BEHAVIOR OF THE PRIMATE. Technical Report No. 3. Joseph C. Sharp and Donald L. Daoust (Walter Reed Army Medical Center. Inst. of Research, Washington, D. C.). [1963]. 33p.

The effects of massive and acute doses of whole-body x irradiation on the performance of a relatively simple, highly motivated task that required periodic response were evaluated in monkeys (Macaca mulatta). Results indicate that complicated or intricate motor manipulations will be severely attenuated by radiation exposure. It was concluded that the use of behavioral indexes will result in a more valid and pragmatic evaluation of the role of ionizing radiations in military and civil defense situations. (C.H.)

35311 (NP-14188) ON THE NUTRITIVE VALUE OF THE MAJOR NUTRIENTS OF IRRADIATED FOODS AND APPRAISAL OF THE TOXICITY OF IRRADIATED FOODS. Progress Report No. 25, September 1, 1963–March 1, 1964. Roberta Bleiler Hill and B. Connor Johnson (Illinois. Univ., Urbana). Contract DA-49-007-MD-544. 10p.

Progress is reported in studies on the effects of radiation processing on the nutritive properties and wholesomeness of beef. Emphasis was placed on the evaluation of losses of sulfur-containing amino acids during electron beam irradiation of meat and a comparison of the effects of thermal processing, gamma processing, and 10 to 12 Mev electron irradiation on the destruction of amino acids in foods. Techniques were standardized for the determination of amino acids. Data are included on the effect of vitamin K deficiency on oxidation of reduced nicotinamide adenine dinucleotide phosphate in rat liver microsomes. (C.H.)

35312 (NP-14196) CAROTENE BIOPOTENCY IN RATIONS CONTAINING GAMMA-IRRADIATED CARROTS AND LIVER CYTOCHROME OXIDASE AND INGESTION OF IRRADIATED MEAT. Report No. 5, September 15, 1963–March 15, 1964. Ian J. Tinsley (Oregon. Agricultural Experiment Station, Corvallis). Contract DA-MD-49-193-62-G42. 6p.

Progress is reported in a study on the effects of radiation processing on the nutritive value and wholesomeness of foods. The biopotency of carotene in irradiated carrots was studied by observing liver vitamin A content in rats raised on rations containing 35% solids as carrots. The irradiation process did not affect liver vitamin A content and growth rate but when rations containing irradiated carrots were stored for 6 months at room temperature before feeding a depressed growth rate and decreased vitamin A content of liver was observed. The effect of oleic acid on essential fatty acid nutrition was evaluated in rats raised on rations containing varying levels of oleic acid. The fatty acid composition of heart and liver mitochondrial lipids was determined. (C.H.)

35313 (NP-14198) FEEDING OF DOGS, RABBITS AND HAMSTERS WITH IRRADIATED SHRIMP AND ITS EFFECT UPON THYROID ACTIVITY (PHASE 1). EFFECT ON RESISTANCE TO INFECTION (PHASE 2). Progress Report No. 14, Six Months Ending March 15, 1964. D. F. Watson. K. G. Libke, R. M. Smibert, and R. W. Engel (Virginia. Agricultural Experiment Station, Blacksburg). Contract DA-49-007-MD-784. 15p.

Includes Supplement.

Dogs were maintained for approximately 2 yr on a diet containing 35% shrimp irradiated with 2.79 megarad or 5.58 megarad. Records were kept on infections in the colony, litter lize, blood protein-bound iodine values, and hematological values. Histological studies were made on sacrificed dogs. Preliminary results are presented. (C.H.)

35314 (NP-14210(p.1-13)) INFLUENCE OF X RADIATION AND VARIOUS CHEMICAL AGENTS ON THE DEVELOPMENT OF A THIOPHOSPHATE-OXIDIZING ENZYME SYSTEM IN THE LIVERS OF MALE RATS. Bernard E. Hietbrink and Marjorie Keshmiri (Chicago. Air Force Radiation Lab.).

Progress is reported in studies on the influence of ionizing radiations on the development of the enzyme system which is responsible for the oxidative desulfuration of a phosphorothioate in the livers of male rats. The effect of daily injections of cortisone acetate on the radiation-induced inhibition of the development of this enzyme system was investigated. Observations were made on the influence of hypophysectomy, ether anesthesia, and surgical trauma on the synthesis of these drug metabolizing enzymes. Experiments were also undertaken to obtain information on the effect of daily injections of hydrocortisone acetate and cortisone acetate on the development of enzyme activity in the livers of orchiectomized animals. (C.H.)

35315 (NP-14210(p.14-24)) INFLUENCE OF X IRRADIATION ON STEROID-INDUCED INCREASES IN THE ACTIVITY OF A DETOXIFICATION ENZYME IN LIVER. Kenneth P. DuBois and Florence Kinoshita (Chicago. Univ. Air Force Radiation Lab.).

The influence of whole-body exposure to x irradiation on the development of liver microsome detoxification enzymes was studied by measuring the development of resistance in adult female and young male rats to the anticholinesterase action of 0,0-diethyl 0-(methylthio-m-tolyl) phosphorothioate (DMP). It was previously established that the in vivo potency of this compound as an anticholinesterase agent is highly dependent upon the stage of development of detoxification enzymes. To ascertain whether single doses of steroids will induce synthesis of detoxification enzymes, a series of adult female rats received a single injection of 2 mgm/kgm of estradiol, methyltestosterone, testosterone, and progesterone. Groups each containing three animals were given 15 mgm/kgm of DMP and sacrificed at 1, 3, and 5 days after treatment with the steroid for measurement of the anticholinesterase action of DMP. Decreased effectiveness of the compound as a cholinesterase inhibitor was indicated by induction of the detoxification mechanism. It was observed that single doses of all of the compounds induced the detoxification system. The most rapid and largest effect was observed with estradiol. These findings suggest that the steroids have the ability to cause a rapid induction of enzyme synthesis like phenobarbital and methylcholanthrene in addition to their apparent slower effect on microsome enzyme synthesis through some other mechanism. To obtain information on the effects of prolonged daily treatment of rats with steroids on the detoxification of DMP, adult female rats were given 2 mgm/kgm/day of estradiol, testosterone, methyltestosterone, progesterone, pregnandione, and androsterone and groups of animals were sacrificed at weekly intervals for measurement of the amount of acquired resistance. All of these steroids caused induction of resistance with estradiol being the most potent. Most of the resistance developed during the first week of treatment and prolongation of the treatment had the ef-

fect of maintaining and slightly increasing the amount of acquired resistance. The effect of radiation on induction of resistance to DMP in young male rats was tested by exposure of 23-day old animals to 400 R followed by daily steroid treatment until the animals were 35 days of age. X irradiation appeared to inhibit induction of resistance by testosterone and progesterone but did not affect the induction by estradiol. (auth)

35316 (NP-14210(p.81-9)) HISTOPATHOLOGIC FINDINGS IN THE TISSUES OF MICE GIVEN DAILY X-RAY EXPOSURES WITH OR WITHOUT LIVER SHIELDING. D. Vesselinovitch, A. Sandberg, J. Doull, and J. Meskauskas (Chicago. Univ. Air Force Radiation Lab.).

Gross and microscopic examination was conducted on tissues of female mice exposed to 40 R, 50 R, 60 R, 100 R, and 150 R of x ray per day to the liver area only and 40 R per day with liver shielded. Moderate to marked atrophy of the lymphoid tissue in the spleen, thymus, and lymph nodes was observed in all mice exposed to 40 R per day of x ray with liver shielding. In some animals exposed to various doses of x irradiation to liver area only, similar lesions were seen in mild degree. Hypocellularity and congestion of the bone marrow was observed in mice with only liver area exposure to x ray, but it was more severe and frequent in animals given 40 R of x ray with liver shielding. Lesions present in the liver consisted of mild to moderate irregularities of the nuclei of the hepatic cells, scattered single cell necrobiosis, and small foci of inflammatory cells. These changes were similar in severity and frequency in both experimental and control mice. (auth)

35317 (RTD-TDR-63-3012) HEMATOLOGICAL CHANGES IN BEAGLES AFTER IRRADIATION BY NEUTRONS, X RAYS, AND RADIONUCLIDES. Jelle de Boer and Ronald E. Engel (Air Force Weapons Lab., Kirtland AFB, N. Mex.). Nov. 1963. 19p. (AD-433980)

Three groups of five beagles were exposed to 400 rads of fission spectrum neutrons, 400 r 250 Kvp x rays, or 10 millicuries of a radionuclide mixture to determine the extent of radiation insult for each dose. The hematological responses observed in each irradiation group were very similar, yet the problem of correlating damage imposed on blood constituents as a function of dose at dose rates received or tissue dose absorbed was not solved. Some interesting and perhaps promising observations were made. Each mode of irradiation with a similar end-result (death) had an optimum damaging effect on a specific day post-irradiation. There were indications that radiation dose can be separated by effect on the blood constituents, and that a dose of 400 rads of pulsed fission spectrum neutrons constitutes an LD_{50-30} and is not comparable to a dose of 400 R x ray which proved to be an LD_{100-17}. (C.H.)

35318 (TID-3912(Index)) EFFECTS OF RADIATION ON THE MAMMALIAN EYE. A Literature Survey. Subject Index. H. D. Lazarus and B. H. Levedahl (California. Univ., Los Angeles). Indexed by Helen L. Ward and William E. Bost (Division of Technical Information Extension, AEC). July 1964. 32p.

A subject index is presented to a literature survey on Effects of Radiation on the Mammalian Eye by H. D. Lazarus. (C.H.)

35319 (TID-7678(p.413-32)) LIVER CONCENTRATION OF THYROID METABOLITES. E. Eric Pochin (Gt. Brit. Medical Research Council. Dept. of Clinical Research, University Coll. Hospital Medical School, London).

In man circulating thyroid hormones are concentrated in the liver with a concentration ratio between liver and plasma of about 3.5 for thyroxin and probably slightly higher for triiodothyronine. The equilibration between liver and plasma appears to be rapid: plasma is cleared of its T-4 at a rate of about 0.12 liter per minute. The hormone then has a mean stay of the order of 40 min before it leaves the liver. The mean stay of the T-3 appears to be shorter and the volume of plasma cleared of this hormone per minute somewhat larger than for T-4. In hyperthyroidism the circulating plasma protein-bound radioiodine is similarly concentrated in the liver. A concentration ratio of 6 was observed in a group of such patients. There is evidence of a somewhat lower concentration of the metabolites in circulation after a therapeutic dose of radioiodine for hyperthyroidism than after test doses. A similar concentration of labeled metabolites was observed during the rapid thyroid-tissue destruction that developed after the administration of 80-millicurie doses of ^{131}I for thyroid ablation in patients with thyroid carcinoma. A demonstration of a hepatic concentration of radioiodine in patients under treatment for functioning thyroid carcinoma may give a useful indication of the persistence of active tumor tissue in such patients and the need for further treatment. (auth)

35320 (TID-19531) CHROMOSOMAL CHANGES IN CANCER PATIENTS FOLLOWING IRRADIATION THERAPY. Shields Warren, Lorraine Meisner, and Anthony P. Amarose (New England Deaconess Hospital. Cancer Research Inst., Boston). [Jan. 16, 1964]. Contract [AT(30-1)-901]. 19p.

Results are reported from in vitro studies of somatic effects of radiation in leukocytes. Cultured leukocytes from therapeutically irradiated cancer patients having approximately one fourth or more of their hematopoietic tissue in the path of 2-Mev x rays were examined for chromosomal aberrations. A marked increase was noted in the frequency of cells with chromosome numbers deviating from the normal compliment of 46. This frequency was observed to increase little with further x ray treatment, and to return to normal within one year following the conclusion of therapy. Structurally abnormal chromosomes produced by irradiation were shown to persist for many years. Although the effects of chemotherapy on chromosomes of cultured leukocytes were similar to those produced by irradiation, the damage was rapidly eliminated. (C.H.)

35321 (TID-20937) CYTOLOGICAL AND ULTRAVIOLET RADIATION STUDIES ON THE CILIATE SPATHIDIUM SPATHULA. Donald B. Williams (Vassar Coll., Poughkeepsie, N. Y.). July 28, 1964. Contract AT(30-1)-3102. 13p.

A relation was found to exist between UV resistance and macronuclear DNA synthesis during the generation cycle of Spathidium spathula. Cells were resistant when macronuclear DNA was being synthesized and were sensitive when it was not being synthesize. Sensitivity also increased as the period since a clone had last undergone excystment or conjugation increased. Four days after irradiation with 10,000 ergs/mm^2 some clones recovered after showing an initial effect, some showed permanent damage, and some produced mixed clones of normal and abnormal cells. (auth)

35322 (TID-20941) THE EFFECTS OF IONIZING RADIATION ON THE CANINE OVARY. Summary of Progress and Final Report, 1963-1964. W. D. Carlson (Colorado State Univ., Fort Collins. Coll. of Veterinary Medicine). Contract AT(11-1)-1202. 47p.

The effects of doses of x radiation ranging from 1,000 to 7,000 R on surgically exposed ovaries of dogs were evaluated at intervals up to 17 mo. after exposure.

Changes in the estrous cycle, characteristics of the vaginal smear, breeding behavior, conception, litter size, viability of offspring, and results of histological examination of the ovaries were recorded. Data on irradiated and control dogs are tabulated. An individual variation in the response to radiation was noted. No apparent effect on reproduction was noted until a certain dose level was reached. Reduction in fecundity appeared to depend on radiation damage in enough follicles to reduce the number that matured during estrus, and the higher the dose the greater the number of injured follicles. Changes in fertility and fecundity were correlated with histological evidence of structural changes with the passage of time. Results are included from a literature review on the effects of irradiation on the ovaries in mice, rats, rabbits, guinea pigs, ferrets, gophers, cats, dogs, monkeys, and humans. (64 references) (C.H.)

35323 (TID-21013) RADIOSENSITIVITY OF ERYTHROPOIESIS AS A FUNCTION OF ITS ACTIVITY. Irma Eskuche and George S. Hodgson (Chile. Universidad, Santiago. Instituto de Fisica y Matematicas). [1962]. Contract AT(30-1)-2488. 20p.

Studies in rats showed that the radiosensitivity of erythropoiesis, as measured by ^{59}Fe uptake by erythrocytes 2 days after irradiation, varied markedly with the activity of erythropoietin at the moment of irradiation. The effects of γ radiation were studied in rats with normal erythropoiesis, with erythropoiesis increased as a consequence of phenylhydrazine injections, with erythropoiesis reduced as a result of fasting, and after the administration of erythropoietin. (C.H.)

35324 (JPRS-25130) THE EFFECT OF STRESS ON THE RADIOSENSITIVITY OF RATS AND THE EFFECTIVENESS OF THE RADIOPROTECTIVE ACTION OF MERCAMINE. P. D. Gorizontov and I. A. Rudakov. Translated from Patol. Fiziol. i Eksperim. Terapiya, 8: No. 2, 17-22 (Mar.-Apr. 1964). 11p. (OTS-64-31508)

The effects of various stages of the general adaptation syndrome (GAS) on the radiosensitivity of rats was investigated. Electrical stimulation was used to induce various degrees of stress in the animals ranging from a stage of alarm, through a stage of resistance, to a stage of exhaustion. A marked increase in radioresistance was noted in rats during the stage of resistance while a reduction of radioresistance occurred in rats irradiated in the initial stage of exhaustion. The various stages of the general adaptation syndrome were also found to affect hematopoietic activity and a possible connection with radioresistance is discussed. The radioprotective action of mercamine was found to change markedly depending on changes in the nonspecific resistance of the body to stress. During the stage of resistance mercamine was most effective while during the initial stage of exhaustion it was practically without effect. (C.H.)

35325 (JPRS-25464(p.8-13)) THE EFFECT OF ANTIBIOTIC THERAPY ON THE CONTENT OF SEROTONIN AND HISTAMINE IN THE BLOOD AND ORGANS OF IRRADIATED RABBITS. Z. A. Popenenkova. Translated from Byul. Eksperim. Biol. i Med., 57: No. 3, 59-61(1964).

A single exposure of rabbits to whole-body x irradiation (950 r) caused a sharp drop in the amount of serotonin (5HT) and histamine in the blood, brain, and small intestine. The phenomenon was associated with a decrease in the number of thrombocytes of the blood, as well as with the disturbance of the enzyme systems which take part in the formation and metabolism of these amines. Prolonged administration of antibiotics did not prevent irradiation-induced changes in the 5HT and histamine level in the blood and organs of the rabbits. A certain lessening of the drop in the 5HT level in the small intestine of rabbits irradiated and treated with antibiotics may be associated with sterilization of the intestine and prevention of bacterial metabolism of dietetic tryptophane as well as with the pharmacological action of the antibiotics. A reduction in the 5HT and histamine content in the blood and organs of unirradiated rabbits during prolonged employment of antibiotics may be explained by the irritating effect of the antibiotics on the hypophysis–adrenal–gland system, resulting in the secretion of hormones which affect the 5HT and histamine level and their exchange, as well as by the direct effect of the antibiotics on 5HT and histamine metabolism. (auth)

35326 (JPRS-25464(p.22-30)) EFFECT OF ANTI-IRRADIATED-TUMOR-TISSUE SERUM ON THE MITOTIC ACTIVITY OF THE EHRLICH ADENOCARCINOMA. S. V. Sukhorukikh. Translated from Byul. Eksperim. Biol. i Med., 57: No. 3, 82-5(1964).

Results are presented from a study of the mitotic activity of tumor cells in the subcutaneous Ehrlich adenocarcinoma of mice exposed to the effects of x rays, under conditions in which serums were administered to them to suppress the tumor tissue irradiated in vitro. Results showed that the serum obtained against the irradiated cancerous antigen induced a more clear-cut inhibition of the growth and development of the Ehrlich adenocarcinoma in irradiated animals as compared with standard anti-tumor and normal serums. It was concluded that such action of the anti-irradiated-tumor-tissue serum was associated with the greater specificity of this serum in relation to x-ray-changed antigens of the tumor and of normal tissues. This fact evidently induces stimulation of the organism's protective forces. However, in cases where, despite the administration of anti-irradiated-tumor serum to mice exposed to the effect of x rays, the tumors developed nonetheless, no marked difference were observed between the mitotic activity in the tumors of animals of this group and the other groups of mice which had been given anti-cancer serums. It is possible that this difference was the result of different experimental conditions. (C.H.)

35327 (JPRS-25630) THE EFFECT OF FRACTIONAL X-RAY IRRADIATION ON THE ACTIVITY OF HEXOKINASE AND ALDOLASE OF THE BRAIN AND MUSCLE TISSUE OF RATS. M. F. Silyaeva. Translated from Vestsi Akad. Navuk Belarusk. SSR, Ser. Biyal. Navuk, No. 1, 101-6(1964). 15p. (TT-64-31902)

Adult rats were given 120 to 240 R of x rays in daily doses of 40 R. Hexokinase and aldolase activity was determined in cerebral hemisphere and skeletal muscle samples taken 15, 30, and 60 days after irradiation. Total fractional irradiation in doses of 120 and 240 R caused a considerable reduction of hexokinase activity in brain tissue in a period from 15 to 60 days following irradiation. In muscle tissue hexokinase reaction increased, with a maximum on the 30th day. Aldolase activity in the brain and cerebellum decreased within 15 and 60 days after irradiation. No change of aldolase activity took place in the muscles under the effect of fractional x-ray irradiation. The most significant changes in the activity of enzymes under study were found under fractional irradiation in doses of 240 R. (H.M.G.)

35328 RADIATION INDUCED "HYPOPHYSECTOMY" AND HYPOTHALAMIC LESIONS IN LACTATING GOATS. C. C. Gale and B. Larsson. Acta Physiol. Scand., 59: 299-318(1963).

Radioinduced lesions were produced in the pituitary gland and/or median eminence-pituitary stalk region of seven lactating goats by use of a narrow, collimated beam of 185 Mev protons from a synchrocyclotron. Radiation doses of 25 to 30 krad were restricted to those structures by rotation of the goats' heads around the vertical and horizontal axes of the planned lesion. Ten to 15 days after pituitary irradiation in four goats, milk production declined steeply over a 10-day period to about 20% pre-lesion levels. In two of the "hypophysectomized" animals with injury also in the median eminence, diabetes insipidus developed concurrently with the onset of lactation block. Daily replacement with prolactin (luteotrophin), somatotrophin, ACTH, triiodothyronine, and insulin had restored milk synthesis to 60% of pre-radiation levels when destruction of trigeminal nerve trunks by continued lateral spread of radio lesions caused an abrupt decline in the health of the goats. In three lactating goats, irradiation of the median eminence/pituitary stalk region was followed after 25 to 30 days by disappearance of the milk ejection reflex; onset of diabetes insipidus characterized by absence of the normal interphase; decline in milk production to 30 to 40% of pre-lesion levels; and in one of them, marked loss of hair. That median eminence lesions blocked lactation secondary to pituitary insufficiency of ACTH, TSH, and STH, but not of prolactin or of oxytocin was suggested by the ability of varied therapeutic regimens to restore lactation. (Excerpta Med., Sect. 23, 1: No. 7, July 1964)

35329 H^3-THYMIDINE AUTORADIOGRAPHIC STUDIES ON CYTOKINETIC RESPONSES TO X-RAY IRRADIATION AND TO THIO-TEPA IN THE NEURAL TUBE OF MOUSE EMBRYOS. Setsuya Fujita, Masakiyo Horii, Takashi Tanimura, and Hideo Nishimura (Kyoto Fritsu Medical Coll. and Kyoto Univ.). Anat. Record, 149: 37-48(May 1964).

First, using the methods of ^3H-thymidine autoradiography and counting mitotic index, cytokinetics of the matrix cells were studied in the telencephalon of normal mouse embryos at ten-days-postconception, and various kinetic constants of the matrix cells were determined: generation time, five hours 20 minutes; mitotic duration, 24 minutes; presynthetic resting time, two hours 36 minutes-one hour 36 minutes; DNA synthetic time, one hour 20 minutes; and post synthetic resting time, one–two hours. Based on this information, effects of two teratogenetic agents, x rays and triethylenethiophosphoramide (thio-TEPA), on the cellular proliferation were analyzed. By x-irradiation (200 R) only proliferating matrix cells are damaged in the neural tube, but not neuroblasts. The radiation induces a temporary block of the flow of the matrix cells through the cell cycle at the late t_2 period so that the mitotic and DNA synthetic cells subsequently decrease in number. Some of the matrix cells that are captured at t_2 period fail to tolerate the block, degenerate and are eliminated from the matrix layer. On the other hand, thio-TEPA, which was proved nontetratogenetic to the central nervous system in this experimental condition, causes a slight prolongation of t_2 duration, but does not significantly influence the proliferative process in the neural tube. (auth)

35330 RENAL CHANGES FOLLOWING RETROGRADE PYELOGRAPHY USING THOROTRAST. W. P. H. A. Rijnders, H. J. Ybema, P. J. Donker, and J. A. G. Ten Berg. Arch. Chir. Neerl., 15: 157-73(1963).

A patient with bilateral thorotrast kidneys was described. The right kidney contained a carcinoma originating from the pelvic mucosa. Moreover, stenosis of the right ureter with hydronephrotic contraction of the kidney had developed. The amount of radiation energy per week that had hit this renal tissue was calculated on the basis of microdeterminations of the quantity of thorium in certain areas of the kidney. The relationship between the thorium deposits in the tissues and the pathogenesis of the carcinoma is discussed. (Excerpta Med., Sect. 23, 1: No. 7, July 1964)

35331 EVALUATION OF DOSE EFFECT CURVES FOR THICK LAYERS. H. Pupke (Deutsche Akademie der Wissenschaften, Berlin). Arch. Geschwulstforsch., 22: 188-92(1963).

An extension of Lea's single hit theory is used for the case that the thickness of the layers of the object to be irradiated is greater than the range of the energy. When the thickness of the layers is known the analysis of the curve allows an estimation of the inactivation volume and of the range. The relative values of the formula are given. (Excerpta Med., Sect. 23, 1: No. 7, July 1964)

35332 MUTATIONS PRODUCED BY RADIOACTIVE ISOTOPES IN PLANT BREEDING. W. Hentrich (Friedrich-Schiller-Universität, Jena, Ger.). Atompraxis, 10: 315-20 (July 1964). (In German)

A general survey of the mutagenic effect of ^{32}P is given, and also of mutations, mutation processes, and mutation breeding. (P.C.H.)

35333 SERUM ENZYME CHANGES FOLLOWING TREATMENT OF LYMPHADENOMA WITH I^{131}. P. Grella (Università, Padua). Attualita Ostet. Ginecol., 9: 880-2 (1963).

An increase in serum malic dehydrogenase and lactic dehydrogenase, which are typical endocellular enzymes, was caused by treatment of the pelvic lymph nodes with ^{131}I. (Excerpta Med., Sect. 23: 1: No. 7, July 1964)

35334 ELECTROPHORETIC AND IMMUNE-ELECTROPHORETIC CHANGES OF THE SERUM OF PATIENTS WITH TUMORS OF THE GENITAL SYSTEM, DURING TREATMENT WITH CHEMICAL AGENTS, WITH RADIUM AND WITH ISOTOPES. G. Abelli and M. Falagario (Università, Padua). Attualita Ostet. Ginecol., 9: 896-906 (1963).

In a comparative study on the electrophoretic and immuno-electrophoretic modifications induced in the serum of patients with neoplasia of the genital apparatus, by means of antimitotics, radium and ^{131}I, variations of the percentual values with respect to the initial values both in the albumin and in the globulin were shown. That is to say, the characteristic behavior of the albumin/globulin ratio is apparent, namely a hyperglobulinaemic disprotidaemia with diminution of the values of the albumin fraction and increase of the α-1, α-2, and γ globulins. On the contrary the β globulins were inconstant in their behavior. At the end of antineoplastic treatment the total proteins always show a lowering of the curve in relation to their initial values. (Excerpta Med., Sect. 23, 1: No. 7, July 1964)

35335 STUDIES ON LYMPHOCYTES. III. EFFECTS OF EXTRACORPOREAL IRRADIATION OF THE CIRCULATING BLOOD UPON THE LYMPHORETICULAR ORGANS IN THE CALF. H. Cottier, E. P. Cronkite, C. R. Jansen, Kanti R. Rai, S. Singer, and C. R. Sipe (Brookhaven National Lab., Upton, N. Y.). Blood, 24: 241-53 (Sept. 1964). (BNL-7370)

Extracorporeal x irradiation of the circulating blood of the calf severely depletes the population of small lymphocytes within the body. The number of circulating blood lymphocytes dropped to a low constant level after 12 hours of extracorporeal irradiation that was maintained up to 48

hours of extracorporeal irradiation. On the other hand the lymphoreticular tissues continued to lose lymphocytes between the twelfth and forty-eighth hour of extracorporeal irradiation. Therefore, the apparent steady-state lymphocyte level in the peripheral blood was maintained by a non-steady-state process in the lymphoreticular organs where the new production of lymphocytes was far insufficient to replace the cells leaving these tissues. The cellular debris caused by extracorporeal irradiation of the circulating blood was found within the spleen, lung, liver, lymph nodes, and elsewhere, in this order of relative concentration. A unique pathologic phenomenon was produced within two days of extracorporeal irradiation of the circulating blood, e.g., a combination of intact or even actively proliferating germinal centers with a marked diminution in the concentration of small lymphocytes. This technic of depletion of small lymphocytes, leaving germinal centers intact, should permit studies for evaluation of the relative importance of germinal centers vs. small lymphocytes in primary and secondary immune responses. The above findings are discussed in relation to lymphocyte production rate, stores, mobilization, and recirculation. (auth)

35336 HEPATIC TUMORS CAUSED BY THOROTRAST IN RATS. G. Grampa and A. Severini (Università, Milan). Boll. Soc. Ital. Patol., 8: 12-14(1963-64).

A study was made in 70 rats, 50 of them being injected with 40 mg of thorotrast (Th) into the femoral veins, and 20 with India Ink (15 mg). Fifty of the animals were castrated and oestradiol (10 mg) was injected into them 20 and 5 days before the administration of the Th. In the animals with Th, hepatocellular adenomas were found in nine, and hepatocellular carcinoma in two cases. The hyperplasias were intimately related to the deposits of Th. The castrated animals had a higher level of Th in the liver. The control animals did not develop tumors. It is concluded that Th acts as an oncogenic agent on account of its radioactivity. (Excerpta Med., Sect. 23, 1: No. 7, July 1964)

35337 THE EFFECT OF HEATING ON SUSCEPTIBILITY TO WHOLE BODY IRRADIATION IN THE MOUSE. Rosalinde Hurley (Queen Charlotte's Maternity Hospital, London), and C. A. F. Joslin. Brit. J. Radiol., 37: 616-19 (Aug. 1964).

The effect of raising the environmental temperature to 37°C on the susceptibility of white Swiss mice to whole body irradiation was studied and enhancement of effect demonstrated for all doses of irradiation in the range 300 R to 600 R. Enhancement was observed if heating preceded irradiation, but not if irradiation preceded heating. The humidity of the atmosphere was found to be an important factor in control groups of heated, unirradiated animals. It is suggested that humidity may also independently affect susceptibility to ionizing radiations and that careful control of this factor may help to reconcile apparently conflicting observations on the effects of temperature change. (auth)

35338 THE EFFECTS OF IRRADIATION ON THE THYROID GLAND WITH PARTICULAR REFERENCE TO THE INDUCTION OF THYROID NEOPLASMS: A REVIEW. Stuart Lindsay and I. L. Chaikoff (Univ. of California, San Francisco and Univ. of California, Berkeley). Cancer Res., 24: 1099-1107(Aug. 1964).

The mode of development of benign and malignant neoplasms in thyroid glands of rats given injections of ^{131}I (10–40 μc) and in glands that had been x radiated (500 to 2000 R) resembled that of adenomas and possibly of a low-grade follicular carcinoma in human thyroid glands that were irradiated with ^{131}I. The parenchyma of rat thyroid glands irradiated with ^{131}I or x rays closely resembled that of human thyroid glands irradiated in a similar fashion. In both cases evidence of irradiation injury, Askanazy changes in epithelial cells, chronic thyroiditis, and the development of neoplasms were observed. In the human being an amount of irradiation comparable with that which regularly induces thyroid carcinomas in rats is generally delivered by ^{131}I or x radiation in treatment for diffuse toxic goiter. In contrast, the development of malignant thyroid neoplasms in the rat 2 years after administration of only 1 μc of ^{131}I appeared comparable with the situation in children in whom malignant neoplasms were found some 7 to 10 years after irradiation of their thymus glands, cervical lymph nodes, or nasopharyngeal lymphoid tissues. No evidence of radiation injury or Askanazy changes in the thyroid epithelial cells were found in rats that received these very small (1 μc) doses of ^{131}I. Neither are degenerative changes that can be ascribed to irradiation evident in the thyroid glands of children developing thyroid carcinoma following thymic irradiation, although these malignant neoplasms have probably been initiated by such radiation therapy. These findings suggest that, both in rats that received small doses of ^{131}I (1 μc) and in infants and children who received low levels of irradiation in the thyroid area, a direct, nonlethal mutant effect on thyroid epithelial cells, caused by radiation, may be responsible for initiation and development of malignant thyroid neoplasms. The finding of chromosome aberration after irradiation of other tissues by either x rays or ^{131}I indicates that such cellular mutations are possible. 92 references. (auth)

35339 ACUTE EFFECT OF GAMMA RADIATION ON DNA SYNTHESIS. Cyrus P. Barnum, Margaret S. Scheller, and N. Paul Herman (Univ. of Minnesota, Minneapolis). Cancer Res., 24: 1155-8(Aug. 1964).

Mice bearing a transplanted lymphosarcoma in ascites form were given whole-body gamma radiation from a ^{60}Co source in doses ranging from 2000 to 20,000 R at a dose rate of 1325 R/min. Incorporation of ^{32}P into the tumor DNA was evaluated in the time interval between 5 and 20 minutes after the end of irradiation and compared with incorporation in nonirradiated controls. The time interval from the mid-point of irradiation to the mid-point of incorporation thus varied from 13 minutes for 2000 R to 20 minutes for 20,000 R. A dose-dependent inhibition of ^{32}P incorporation into DNA was noted, and the dose-response curve appeared to plateau at 50 percent of the incorporation observed in nonirradiated controls. (auth)

35340 THE TREATMENT OF ACUTE LOCAL RADIATION INJURIES. R. D. Sweet (South Devon and East Cornwall Hospital, Plymouth, Eng.). Clin. Radiol., 15: 55-8 (1964).

Burns resulting from therapeutic overdoses of soft x rays are described. All but one were treated conservatively and most were given large doses of prednisolone by mouth during the acute stages. This probably lessened pain and helped restore function, but is unlikely to have been of any long-term benefit. The place of surgery in x-ray burns of hands is discussed, and it is concluded that skin grafting should be performed wherever healing is not complete by 3 mos after exposure to the x rays, but not earlier unless full thickness skin loss occurs. (Excerpta Med., Sect. 23, 1: No. 7, July 1964)

35341 EFFECTS OF RADIOACTIVE ISOTOPES ON THE CONTENT OF ASCORBIC AND ORGANIC ACIDS. N. B. Vezirova (Inst. of Botany, USSR). Dokl. Akad. Nauk Azerb. SSR, 19: 53-7(1963). (Azerbidzhan)

In most, but not all, cases the presence of ^{32}P and ^{59}Fe increased the ascorbic acid content of plant leaves. The effect was especially favorable with 1 and 25 μc. The effectiveness, particularly of the iron, decreased with increasing dose. The fact that results were not the same in all cases is probably related to the highly labile nature of the ascorbic acid and to other conditions resulting from the irradiation. These isotopes, particularly ^{32}P at a dose of 25 μc per plant, increased the organic acid content in leaves and fruits of tomatoes and eggplants. (tr-auth)

35342 VARIATIONS IN THE ENZYMIC AND OPTICAL ACTIVITY OF LYSOZYME IRRADIATED WITH ELECTRONS AND PROTONS. N. A. Kravchenko, V. P. Zrelov, and E. I. Klabunovskii. Dokl. Akad. Nauk SSSR, 155: 1449-51(Apr. 21, 1964). (In Russian)

Changes in enzymic and optical activity of lysozyme resulting from the action of relative fast electrons (^{204}Tl) and protons (synchrocyclotron) with an ionizing potential of only 2 to 3 Mev/cm^2.g were studied. The experimental data show that the enzymatic activity of preparations irradiated in a vacuum increases rapidly, reaching 120% at a dose of 3.2×10^5 Rads and then slowly decreases. There is some change in the specific optical activity, but when the irradiated preparation is kept at 0°C in an evacuated ampule, the increased activity is gradually lost. After 2 to 3 months the optical activity of the preparation is equal to that of the initial. When the irradiation is in the presence of air and moisture, the activation effect is lower, although fairly regular. Apparently the initial action of the electrons results in definite structural changes in the lysozyme molecule, which are the opposite of denaturation. The new molecule may be labile and in time reconverted to the original state. The presence of water during the irradiation stabilizes the original structure. The actions of electrons and protons are exactly opposite, which indicates that the sign of the charge of the radiation is important. Preliminary work on chromatographed preparations with high enzymic activity showed that such lysozyme is a mixture of native protein with products that are both more active and partially inactivated. (TTT)

35343 THE ROLE OF RADIOTOXINS IN DISTURBING THE SHAPE OF IRRADIATED PLANTS. L. M. Kryukova and A. Kasymov (Inst. of Biological Physics, Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 156: 1204-6 (June 11, 1964). (In Russian)

The sunflower plant (Helianthus annuus) blossoms only from the upper buds, and the lower buds in the leaf axils do not blossom unless the upper buds are removed. The development of the lower buds was observed on irradiating the upper stem with x rays after removal of the upper buds. The rest of the plant was shielded with 5 mm lead. Measurements showed that the shielded part of the plant received a dose of only 21 R, which was 0.08% of the total dose of 25,000 R to the upper stem. A control experiment on a sunflower plant given a dose of 1000 R showed that no change in the shape of the plant takes place with these doses. The irradiated plants remained dormant longer than the controls, and gave deformed blossoms containing primarily hollow seeds. The experiments were repeated three times with identical results. The data show that radiotoxins formed by the local irradiation are translocated and have an effect on the shape of the flowers that are developed subsequently. The average number of seeds from 4 calathides in the control plants was 63 ± 1.8, and the number was 10 ± 0.5 in the irradiated plants. A total of 25 control seeds sprouted (100%), while only 1 seed out of 20 seeds from the irradiated plants sprouted. This plant showed leaf bifurcation. Thus, it was concluded that the radiotoxins that have an effect on plant shape also have an effect on hereditary factors. (TTT)

35344 MUTATION FREQUENCIES IN SUCCESSIVE SPERM EJACULATES OF X-RAYED DROSOPHILA MELANOGASTER MALES. Oeistein Stroemnaes and Ingerid Kvelland (Univ. of Oslo, Blindern, Norway). Genetics, 50: 337-49(Sept. 1964).

Four groups of unmated wild-type Oslo males were irradiated with 3000 R of x rays when the males were 0 to 2 hours, 12, 24, or 72 hours of age. After irradiation the males were permitted to mate ad libitum for 12 hours, which was followed by a 12-hour period without females, and again a 12-hour mating period. All matings were observed and recorded, and the offspring from each individual mating were examined for the induction of Minutes, recessive sex-linked lethals, and translocations. An age effect was reflected in the mutation frequency of the sperm ejaculated during the first mating period, but not during the second mating period. The induced-mutation frequencies observed in the first mating period were always higher than the frequencies induced in the sperm available in the second mating period. The difference in induced mutation frequency between the two mating periods is ascribed partly to recovery and partly to differential sensitivity. (auth)

35345 FITNESS OF POPULATIONS OF IRRADIATED MICE: PLAN OF EXPERIMENTS. Earl L. Green (Jackson Lab., Bar Harbor, Maine). Genetics, 50: 417-21(Sept. 1964).

Two experiments are described that were planned to detect the effects, if any, of high-energy radiation on the genetic fitness of small populations of mice, propagated for several generations with four different levels of inbreeding. The radiation doses of 0, 50, and 100 R were applied in each generation to the gonads of the males with bodies shielded. Matings were made up seven weeks after exposure to minimize the effects of radiation on reproductive cells other than spermatogonia. In one experiment, the initial mice were genetically homogeneous, all being descendants of a single pair in the C57BL/10Gn strain. In the other experiment, the initial mice were genetically heterogeneous, all being descendants of double-cross hybrids between four inbred strains: C57BL/6J, BALB/cJ, DBA/2J, and C3HeB/FeJ. The possible indicators of radiation damage to the genetic constitution of the populations include reproductive performance and physiological fitness. (auth)

35346 REPRODUCTIVE FITNESS OF IRRADIATED POPULATIONS OF MICE. Earl L. Green (Jackson Lab., Bar Harbor, Maine). Genetics, 50: 423-34(Sept. 1964).

Mated pairs of mice, randomly selected from 12 genetically homogeneous or inbred populations and from 12 genetically heterogeneous or hybrid populations and not themselves irradiated, were set out after 0, 3, 6, and 9 generations of spermatogonial irradiation to yield measures of lifetime reproductive performance. Each set of 12 populations represents all possible combinations of three radiation dose levels and four inbreeding levels. The radiation doses were 0, 50, and 100 R applied to the testes, with bodies shielded, in each generation. The inbreeding levels were varied by controlling the number of breeding pairs per generation in each line. Matings were made up seven weeks after exposure to radiation. Therefore any genetic effects are the result of mutations induced in spermatogonia. Reproductive fitness was measured as the fraction of fertile matings, the length of reproductive life, the num-

ber of litters, and the total number of progeny weaned in lifetime tests of reproductive performance. Reproductive fitness was unaffected by the variations in inbreeding level or by the variations in spermatogonial irradiation for at least six generations. After nine generations differences appeared between the inbred and possibly also between the hybrid populations associated with the amount of spermatogonial radiation. Factors other than the radiation exposure, including unintentional selection, may account for the different responses of the irradiated lines. Spermatogonial irradiation at low levels for several consecutive generations appears to lead to the accumulation of mutations which depress the reproductive fitness of nonirradiated progeny. (auth)

35347 MITOTIC RECOMBINATION AND HETEROALLELIC REPAIR IN SACCHAROMYCES CEREVISIAE. D. D. Hurst and S. Fogel (Brooklyn Coll.). Genetics, 50: 435-8(Sept. 1964).

Two diploids, heteroallelic at the histidine-1 locus (hi_{1-1}/hi_{1-7}), were prepared in coupling and repulsion for closely linked flanking thr_3 and ar_6 markers, with an additional marker, tr_2, distal to ar_6, heterozygous in the second diploid. The first diploid was treated with ultraviolet irradiation (UV) which increased the HI prototroph frequency, but with increased UV dose the proportion of recessive homozygosis among prototrophs decreased. The second diploid was plated for prototrophs as a young clone, and as an aged clone, and was sporulated and plated for haploid prototrophs. Tetrad analysis of the diploid HI prototrophs revealed high genotypic heterogeneity. The double mutant expected of reciprocal recombination was also found in low frequencies. Prototrophs from the aged clone were about 70 percent haploid, and the remaining diploids showed high recessive homozygosis for heterozygous input markers, reflecting a high incidence of meiosis in the clone. The haploid HI prototrophs from asci were distributed into eight genotypic classes, unequal in size. The frequencies of crossing over in the distal ar-tr interval indicated that positive interference was observed in some genotypic classes (postulated as recombinant between the heteroalleles) and not in others (postulated to be reversions of the hi_{1-7} input allele). The hi_{1-1} mutant is considered as a deletion. These observations are discussed with respect to hypotheses involving exchanges between homologues or intrachromosomal events. It is postulated, that mitotic recombination reflects the occurrence of generalized chromosome synapsis (the onset of meiosis) followed by mitotic centromere disjunction. This process has been called parameiosis. (auth)

35348 PERSISTENCE OF POPULATIONS OF MICE EXPOSED TO SUBSTERILIZING DOSES OF SPERMATOGONIAL X-IRRADIATION. Earl L. Green and Edwin P. Les (Jackson Lab., Bar Harbor, Maine). Genetics, 50: 497-507(Sept. 1964).

Small populations of inbred and hybrid mice were exposed to the effects of high, but substerile doses of x irradiation applied to the paternal gonads for 1 to 7 generations. Each population had eight pairs per generation, random-mated except that brother-sister matings were avoided. The inbred mice were descendants of a single pair in the C57BL/10Gn strain. The hybrid mice were descendants of double cross hybrids produced by crosses between the C3HeB/FeJ, C57BL/6J, BALB/cJ, and DBA/2J strains. The doses of x rays, 200 R for inbred and 900 R for hybrid mice, were applied 7 weeks before mating. The germ cells were thus irradiated as spermatogonia. The populations were compared with respect to the number of fertile matings, the number of mice born and weaned from the first two litters, the intervals of time between makeup and birth of the first litter and between the first and second litters, and the male fractions. None of the populations were extinguished genetically by these high doses of radiation, nor have any of the indicators of radiation damage used shown any systematic effects of radiation. The results are interpreted to mean either that the radiation-induced mutations are almost exclusively recessive and that the rare homozygotes are selected against without affecting the statistical properties of small populations, or that the measures of fitness and the sizes of samples in these experiments were not adequate to detect differences between the irradiated and control populations. (auth)

35349 POSTRADIATION EFFECT IN STORED BARLEY SEEDS IRRADIATED BY GAMMA-RAYS (Co^{60}) IN THE STATE OF ORGANIC AND FORCED DORMANCY. N. I. Nuzhdin, R. L. Dozortseva, and N. S. Samokhvalova (Inst. of Genetics, Moscow). Izv. Akad. Nauk SSSR, Ser. Biol., No. 4, 577-86(July-Aug. 1964). (In Russian)

Seeds of two varieties of winter barley were irradiated in the air-dry state with gamma rays from ^{60}Co at a dose of 10 kr, the radiation intensity being 343 R/min. The postradiation effect during the storage of irradiated seeds was investigated by the frequency of cells with chromosome aberrations in the meristem of root tips. It was shown that in the seeds irradiated during a state of forced dormancy the effect of storage was manifested by an increase in the percentage of cells with chromosome aberrations practically from the moment of irradiation. A sharp decrease in the percentage of such cells was observed during the first two days after irradiation. In the seeds irradiated during a state of organic dormancy the effect of storage was revealed only after the seeds emerged from this state. Prior to this, no matter how long the seeds were stored, no effect of storage was observed. (auth)

35350 RESEARCH ON PANCREATIC RIBONUCLEASE. IV. A NOVEL ARTIFICIAL RIBONUCLEASE OBTAINED BY γ-RAY IRRADIATION OF RIBONUCLEASE-A IN THE PRESENCE OF CYTIDINE 2′(+3′)-PHOSPHATE. Tyunosin Ukita and Keizo Waku (Tokyo Univ.). J. Biochem. (Tokyo), 55: 420-31(Apr. 1964).

The effect of γ irradiation on an aqueous solution of RNase-A was investigated. After irradiating a solution containing RNase 1 mg/ml with 5×10^{-5} R, 70% of the original enzymatic activity was destroyed. The degree of inactivation of RNase by γ irradiation in the presence of several substrate analogs, which are competitive inhibitors of the enzyme, was investigated. In using pyrimidine substrate analogs, a correlation was observed between their protective characteristic against γ irradiation and their strengtl in inhibitory activity with respect to RNase-A activity, but in purine substrate analogs no such correlation could be observed. A new protein product retaining the same enzymatic activity as that of RNase was obtained when RNase was irradiated with γ rays in the presence of cytidine 2′(+3′)-phosphate which is known to be the most active competitive inhibitor of RNase. The new protein was found to be homogeneous by ultracentrifuge, column chromatography and electrophoresis examinations. From these observations, it was inferred that cytidine 2′(+3′)-phosphate prevented the disorganization and degradation effect of γ rays on the active center of RNase-A. The amino acids which were degraded by γ irradiation, therefore, were probably not related to the active center of RNase. (auth)

35351 RADIOSENSITIVITY IN ESCHERICHIA COLI. J. Greenberg and P. Woody-Karrer (Palo Alto Medical Research Foundation, Calif.). J. Gen. Microbiol., 33: 283-92(1963).

A radiosensitive mutant of Escherichia coli strain K12, w3747 was found to be similar to E. coli strains B and S with respect to survival following ultraviolet irradiation, plating-medium recovery, ability to reactivate irradiated T1 phage, and in its cross-resistance pattern with radiomimetic chemicals. In all these respects the radiosensitive E. coli strain K12, AB1186, isolated by Howard-Flanders, was found to resemble the Hill radiation hypersensitive strain B_{s-1}, and, except in the ability to reactivate irradiated T1 phage, strain B_{s-2}. Strains w3747, and AB1886 acquired sensitivity to radiomimetic chemicals concomitantly with radiation sensitivity. Strains B_{s-1} and B_{s-2} on becoming hypersensitive to radiation did not become correspondingly hypersensitive to radiomimetic chemicals. In fact, they acquired a small degree of resistance to these chemicals, relative to strain B, and a substantial increase in resistance to 1-methyl-3-nitro-1-nitrosoguanidine and proflavine. These results are discussed in terms of known genetic loci implicated in radiation sensitivity and resistance. (Excerpta Med., Sect. 23, 1: No. 7, July 1964)

35352 EFFECT OF X-IRRADIATION OF THE POPLITEAL LYMPH-NODE ON ITS OUTPUT OF LYMPHOCYTES AND IMMUNOLOGICAL RESPONSIVENESS. J. G. Hall and Bede Morris (Australian National Univ., Canberra). Lancet, 1: 1077-80(May 16, 1964).

Chronic fistulae were established in the different ducts of the popliteal lymph-nodes in nine sheep, and the lymphocyte output of each node was measured. The lymph nodes were subjected to 800–2000 R of x irradiation, and in all cases this caused a significant fall in the lymphocyte output in the efferent lymph. However, except for a transient disturbance immediately after irradiation, there was little change in the morphology of the cells of the efferent lymph. Five preparations were stimulated antigenically 6 to 140 hours after the lymph nodes had received 2000 R. The resulting increases in antibody titre and the characteristic changes in the cellular composition of the lymph showed that the immunological responsiveness of the nodes had not been altered significantly by irradiation. These results suggest that the functional capacity of the lymphoid component of a lymph node depends substantially on the entry of recirculating lymphocytes derived from the pool of lymphocytes in the body rather than on the primary production of lymphocytes within the node. (auth)

35353 INFLUENCE OF ROENTGEN IRRADIATION ON INTERNAL IRON METABOLISM. P. Nicola, E. Madon, and A. Ponzone (Università, Turin). Minerva Pediat., 15: 1345-9(1963).

A study was made of the influence of total and partial irradiation by x rays on the internal metabolism of iron estimated by means of radioiron. The experiments were carried out on three groups of rabbits. Neither partial nor total irradiation had any appreciable effect on the rate of removal by the blood flow of iron introduced intravenously into the transferrin vehicle. On the other hand, hemoglobin incorporation was severely and immediately impaired by total irradiation, whereas with partial irradiation the involvement was less severe. The various theories to explain interference with, and the functioning of erythropoietic tissue are discussed. (Excerpta Med., Sect. 23, 1: No. 7, July 1964)

35354 RECOVERY FOLLOWING X-IRRADIATION OF SYNCHRONIZED CHINESE HAMSTER CELLS. W. K. Sinclair and R. A. Morton (Argonne National Lab., Ill.). Nature, 203: 247-50(July 18, 1964).

The process of repair of sub-lethal damage in synchronized populations of Chinese hamster cells from two doses of x radiation separated by various time intervals is discussed. It was concluded: that Chinese hamster cells in the S period that survive a first dose of x radiation, repair fully the damage incurred; the repair process is rapid and may be complete in about two to three hrs; during the recovery process, the cells continue to progress through the cycle, although more slowly than unirradiated cells; and the kinetic pattern of recovery for asynchronous cells exposed to fractionated doses is due to the combined effects of partial synchronization of survivors, rapid recovery from sublethal damage, and subsequent cell progression through the cycle. (H.M.G.)

35355 SEGREGATION OF RADIATION-INDUCED MUTATIONS IN ESCHERICHIA COLI. R. J. Munson and Bryn A. Bridges (Medical Research Council, Harwell, Berks, Eng.). Nature, 203: 270-2(July 18, 1964).

Experiments on Escherichia coli indicate that the number of mutable units per nucleus, derived from the average numbers of mutable units and of nuclei per bacterium, depends on temperature. The segregation of mutable units in E. coli was followed after short x-ray exposures of cultures in the process of exponential growth under full aeration. Prototrophs and auxotrophs were scored on minimal agar plates supplemented with tryptophan. The mutation rate per nucleus was derived from observations of mutant frequency in suspensions of log phase E. coli WP2 irradiated under aeration in minimal medium without glucose or tryptophan. Mutation rate per mutable unit was determined in continuous cultures grown under continuous gamma irradiation. Observed segregation patterns at the different temperatures lead to the following conclusions: at 37° one basic (non-replication) nucleus contains one unit mutable by x or γ rays; and the larger average number of mutable units per nucleus at 16° implies that approximately half the mutational events are confined to one strand only or alternatively that there is a G_2 non-DNA-synthesizing period in the cell cycle lasting about half a generation time. (H.M.G.)

35356 EFFECT OF γ-RADIATION ON DEOXYNUCLEOPROTEIN ACTING AS A PRIMER IN RNA SYNTHESIS. J. J. Weiss and C. M. Wheeler (Univ. of Newcastle upon Tyne, Eng.). Nature, 203: 291-2(July 18, 1964).

The effects of γ radiation on deoxynucleoprotein (DNP) and DNA while acting as primers for RNA synthesis were investigated. Results for the DNA primed synthesis show that a dose of 2000 rads reduces the priming activity by 50%, whereas irradiation of DNP with a 12,000-rad dose causes only a 30% reduction in RNA synthesis. The results are explained in terms of a non-complexed DNA molecule. (H.M.G.)

35357 RESISTANCE AGAINST CARCINOMAS OF THE SKIN INDUCED BY DIMETHYLBENZANTHRACENE (DMBA) IN MICE OF THE STRAIN XVII/Bln. G. Pasternak, A. Graffi, F. Hoffmann, and K.-H. Horn (Inst. for Experimental Cancer Research, Berlin). Nature, 203: 307-8(July 18, 1964).

Induction of resistance in mice against isologous cell inocula of DMBA-induced skin carcinomas is reported. Female mice were immunized by subcutaneous injection of x-irradiated tumor suspensions. Challenge injections were given one day after the last immunizing injection.

Resistance-induction was studied in two types of tumors: carcinoma 572 and carcinoma 788. Results of 65, 60, and 48 per cent resistant animals 25, 32, and 39 days after challenge injection in the test group as compared with 3 per cent in the control group are statistically significant. It is concluded that tumor-specific antigenicity is a characteristic of carcinomas induced by carcinogenic hydrocarbons. (H.M.G.)

35358 PRODUCTION BY X-RAYS OF PETITE COLONIES IN YEAST AND THEIR RADIOSENSITIVITY. H. Laser (Univ. of Cambridge, Eng.). Nature, 203: 314-15(July 18, 1964).

Production of petite colonies was studied in an x-irradiated diploid strain of baker's yeast. The number of petite colonies among survivors increased with increasing x-ray dose in an irregular manner, the highest yield being 25%, after which it began to decrease to almost zero on further dose increase. No relation between x-ray dose, percentage of petite colonies, and reversion to large type was established. Techniques for obtaining a strain of petite cells that breed true are described. Differences between radiosensitivity of large and petite strains were not found. Experiments in which survivors were irradiated repeatedly showed that further irradiation failed to raise the degree of radioresistance. It is concluded that the initially produced petite cells are not due to genetic difference of the two strains. (H.M.G.)

35359 INFLUENCE OF CHRONIC GAMMA-IRRADIATION ON THE YIELD OF CHROMOSOMAL ABERRATIONS IN RAT LIVER CELLS. I. M. Shapiro (Inst. of Animal Morphology, Moscow), S. P. Yarmonenko, and G. F. Paliga. Nature, 203: 315-17(July 18, 1964).

Female mice were exposed to 150 rads of ^{60}Co γ rays given either in acute or chronic doses. Partial hepatectomy was carried out 24 hr after irradiation, and the animals were killed 30 hr after the operation. A number of cells with chromosome aberrations was assessed among 100 late anaphases and early telophases in each animal. The percentage of cells with chromosomal aberrations diminished with dose-rate decrease. About 60% of the cells with aberrations had one acentric fragment. The distribution of cells with one, two, and more acentric fragments with bridges, etc., did not significantly change at various irradiation times. (H.M.G.)

35360 CLINICAL-RADIOLOGICAL AND MORBID-ANATOMICAL CONSIDERATIONS ON TWO CASES OF THOROTRASTOSIS. U. De Ferrari. Osped. Maggiore, 58: 878-97(1963).

Two cases of thorotrastosis are described. A thorough study was made of the first case from the clinical, radiological, and histological points of view. The radioactivity was checked in the patient and in the operation specimen (the spleen). In both instances it was positive. In the second case, in which there was a history of introduction of thorotrast as far back as 25 yr previously, a study was made solely from the clinical and radiological points of view. Here, too, the investigation for radioactivity in the body of the patient gave a positive result. (Excerpta Med., Sect. 23, 1: No. 7, July 1964)

35361 INACTIVATION OF SOLUBLE RIBONUCLEIC ACID BY ELECTRON IRRADIATION. Faiza Fawaz-Estrup and Richard B. Setlow (Yale Univ., New Haven). Radiation Res., 22: 579-85(Aug. 1964).

The radiation-sensitive molecular weight (RSMW) of soluble ribonucleic acid (S-RNA) from yeast was determined from the decrease of amino acid-binding power produced by 1-Mev electrons. The RSMW's for S-RNA-valine, -leucine, -alanine, -methionine, -isoleucine, and -proline were found to be 8300, 29,000, 17,000, 12,000, 16,000, and 12,000, respectively. The RSMW's for valine-activating and leucine-activating enzymes from rat liver were 31,000 and 28,000, respectively. (auth)

35362 RESPONSE OF THE POCKET MOUSE TO IONIZING RADIATION. J. J. Gambino and R. G. Lindberg (Northrop Corp., Hawthorne, Calif.). Radiation Res., 22: 586-97(Aug. 1964).

Several hundred pocket mice representing two species, Perognathus longimembris and P. formosus, were administered single doses of whole-body x and γ radiation. Exposure doses of 400, 600, 800, 1000, 1200, 1400, 1600, 1800, and 2000 R were used. Radiation at the highest dose levels only (>1200 R) resulted in significant numbers of acute (30-day) deaths. The $LD_{50\,(30)}$ for pocket mice in this experiment (1300 R for P. formosus; 1520 R for P. longimembris) is two to three times that reported for related mammalian forms. Postirradiation hematological changes as evidenced by total and differential blood counts, hematocrits, hemoglobins, etc., corroborate the extreme radiation insensitivity reflected in survival curves. Leukocyte depression was maximum at 5 days postirradiation. At 1400 R the magnitude of the leukocyte depression was of the same order as that observed in other rodents receiving 400 to 500 R. Since radiation was administered while the animals were in a normothermic state, the low mortality suggests a high degree of natural radiation resistance. This resistance may be related to certain unique physiological adaptations of the pocket mouse that enable it to survive in the desert environment. In contrast, the kangaroo rat, which is a desert form with similar adaptations has an LD_{50} corresponding closely to that of the other small mammals. These results suggest that Perognathus may be the most radioresistant of any mammals tested to date. (auth)

35363 INFLUENCE OF X RADIATION ON DEVELOPMENT OF ENZYMES RESPONSIBLE FOR DESULFURATION OF AN ORGANIC PHOSPHOROTHIOATE AND REDUCTION OF p-NITROBENZOIC ACID IN THE LIVERS OF MALE RATS. Bernard E. Hietbrink and Kenneth P. DuBois (Univ. of Chicago). Radiation Res., 22: 598-605(Aug. 1964).

A study was conducted on the influence of x ray on the development of an enzyme in liver microsomes that catalyzes the oxidative desulfuration of phosphorothioates. Exposure of 23-day-old male rats to 200 R or 400 R almost completely inhibited the development of phosphorothioate-desulfuration activity during the first 3 weeks after exposure. Substantial inhibition of the development of the enzyme activity was also observed after exposure of the animals to 100 R. The enzyme activity of unirradiated young rats reached adult levels at 45 days of age. In contrast, the livers of animals given 100 R or 200 R did not exhibit normal adult activity until the rats were 53 to 58 days of age. Marked inhibition of the development of the enzyme activity by x ray was also observed in the regenerating livers of partially hepatectomized rats. Radiation had no inhibitory effect on the phosphorothioate-oxidizing enzyme activity of the livers of adult male rats. These findings suggest that the effect of x ray is on the development of the enzyme-synthesizing process. X radiation had no effect on the development of reductase activity in the livers of young rats. (auth)

35364 IRRADIATION-INDUCED CROSSLINKING OF COLLAGEN. A. J. Bailey (Cambridge Univ. and Agricultural Research Council, Cambridge, Eng.), D. N. Rhodes, and C. W. Cater. Radiation Res., 22: 606-21(Aug. 1964).

Collagen fibers of rat-tail tendon were exposed, under various conditions, to doses of ionizing radiation up to 20 Mrads. A considerable decrease in solubility and an increase in tensile strength of the thermally contracted fibers occurred when the fibers were irradiated in the presence of water, whereas when they were irradiated dry the solubility increased and the tensile strength decreased. These results are explained by the formation of intermolecular crosslinks between molecules of the orientated protein chains in addition to protein chain scission, the former process predominating in the presence of water, which either provided radicals for initiation of crosslinking by an indirect action, or maintained the mobility of the protein chains in the hydrated structure. The extent of the crosslinking was determined by stress-strain analysis. The possible nature of these bonds is discussed. (auth)

35365 RECUPERATION FROM LETHAL INJURY BY WHOLE-BODY IRRADIATION. I. KINETIC ASPECTS AND THE RELATIONSHIP WITH CONDITIONING DOSE IN C57BL MICE. Robert F. Kallman and Giovanni Silini (Stanford Univ., Palo Alto, Calif.). Radiation Res., 22: 622-42 (Aug. 1964).

Mature male C57BL mice were irradiated, whole-body, either with single 250 kv x ray doses of short duration or with graded series of second doses at different times after one of three constant conditioning doses (D_c). Second doses were administered at 2-hour intervals during the first 12 hours and at 6- to 12-hour intervals thereafter up to 48 hours. The LD_{50}'s were determined for the 30 days post-irradiation, and these data were used for the calculation of residual injury and recovery, or roentgens repaired. The percent residual injury remaining after all three D_c's showed characteristic fluctuations, with a minimum (period of marked second-dose refractoriness) falling at 4 to 9 hours and a maximum at 8 to 10 hours. The data were suggestive of a continuation of these fluctuations as a cyclic phenomenon in the period between approximately 12 and 48 hours, and this was borne out by additional experiments in which mortality was determined after constant second doses given at 2- to 3-hour intervals for the entire 48 hours after a D_c of 154 R. The magnitudes of the initial minima and maxima in percent residual injury were independent of the size of the D_c. The decay in percent residual injury in the 12- to 48-hour period could be regarded as an exponential function with superimposed cyclic fluctuations. The rate of decay was strongly first-dose-dependent, proceeding more slowly, the higher the D_c. The same data, however, analyzed for recovery, in absolute number of roentgens repaired per hour, did not differ significantly for the three D_c's during this same period, and an arithmetically linear relation between roentgens repaired and time was adequately fitted to the experimental points. The significance and interpretation of the findings are discussed in terms of a hypothesis which relates the observed LD_{50}'s to the probabilities of survival of individual marrow stem cells, and the changes in LD_{50} to the combined effects of cellular depopulation and synchronization in the postirradiation growth of first-dose surviving cells. At the time of conditioning irradiation the cell population is assumed to be heterogeneous with respect to the stages of the generation cycle and therefore with respect to stage-dependent radiosensitivity. The first dose effectively synchronizes the surviving cells so that their net radiosensitivity assumes different levels at different times. (auth)

35366 EXTENSION OF LIFE SPAN OF LEMNA PERPUSILLA CLONE 6746 BY ULTRAVIOLET IRRADIATION. Marinus J. Dijkman, Manley L. Boss, and Ethel R. Russell (Univ. of Miami, Coral Gables, Fla.). Radiation Res., 22: 662-7(Aug. 1964).

Fronds of a clone of Lemna perpusilla derived from one frond of Hillman's clone 6746 were exposed daily to ultraviolet radiation at 4500 ergs/sec/cm^2 at 2537 A, for 0 to 240 seconds per day. The treatment for the experimental groups varied from each other by an increment of 30 seconds of exposure. Increased life spans were noted in these groups exposed to daily treatments of 30, 60, and 90 seconds of irradiation. Daughter frond production was significantly higher among fronds irradiated for 30 seconds daily. Hypotheses concerning these responses are discussed. (auth)

35367 LIPID BIOSYNTHESIS BY HUMAN BONE MARROW CELL CULTURES AND GAMMA RADIATION. C. J. Miras, J. D. Mantzos, and G. M. Levis (Univ. of Athens). Radiation Res., 22: 682-92(Aug. 1964). (TID-20521)

Labeled fatty acids were synthesized when acetate-1-^{14}C was added to human bone marrow cell cultures. Gas-liquid chromatography showed that the saturated acids consisted mainly of palmitic and stearic acid. The unsaturated fraction contained C-18:1, C-20:1, C-22:1, and C-24:1, and C-18, C-20, and C-22 polyunsaturated. The pattern of synthesized fatty acids suggests that both the de novo and the elongation system contribute to the synthesis. Thin-layer chromatography and silicic acid column chromatography show that the synthesized fatty acids are incorporated into most of the lipid fractions and mainly into triglycerides, phosphatidylethanolamine, and phosphatidylcholine, with a small perponderance of the neutral lipids. Irradiation with doses ranging from 500 to 2000 rads produced an effect suppressing the rate of fatty acid synthesis by about 30 to 60%, depending on the dose and the time lapse between irradiation and incubation. The data suggested that the de novo synthesizing system is more affected by irradiation than is the elongation system. The dose-response curve seems to consist of more than one component; the possibility that the steeper component of the curve is due to an effect on the more immature cells is discussed. (auth)

35368 THE COMBINED EFFECTS OF THERMAL TRAUMA AND X-IRRADIATION ON EARLY MORTALITY. F. A. Valeriote and D. G. Baker (Univ. of Toronto). Radiation Res., 22: 693-702(Aug. 1964).

The administration of a sublethal thermal trauma (second to third degree burns) caused a significant decrease in survival in rats exposed to x ray doses between 550 and 750 R. The increase in mortality in the case of the combined injuries was confined to the time period characteristic of injury to the gastrointestinal tract, that is, 3 to 8 days after x irradiation. Antibiotic therapy was found to be ineffective in combating this synergism. The strain of rats used in this experiment exhibited a decrease in water intake coupled with anuria after x irradiation, which suggests that the frequently noted polydipsia and polyuria was strain-dependent. (auth)

35369 EFFECTS OF GENOTYPE ON RADIOSENSITIVITY OF VIBRISSAE. Berenice Kindred (Commonwealth Scientific Industrial Research Organization, North Ryde, New South Wales, Australia). Radiation Res., 22: 703-12 (Aug. 1964).

Tabby and normal mice from high and low vibrissa selection lines and from an unselected stock were x-rayed at different stages of development, and the effects on the primary and secondary vibrissae were studied. In all cases the greatest effect followed irradiation at 11.5 days of fetal life, and the mutants were more susceptible. (auth)

35370 RIBONUCLEIC ACIDS IN X-RAY-INDUCED CATARACTS. Anima Devi and Renuka Banerjee (Inst. for Medical Education and Research, Chandigarh, Punjab, India and R. G. Kar Medical Coll., Calcutta). Radiation Res., 22: 713-21(Aug. 1964).

The effect of ionizing radiation on the RNA of the rat lens was investigated. The result indicates that x irradiation primarily affects the lens epithelium in such a way that the production of RNA in the soluble fraction of lens material is diminished. Ionizing radiation does not affect the total content of the insoluble RNA but weakens the peptide bonds of the protein (albuminoid) so much that the perchloric acid treatment of the insoluble protein of x irradiated lenses releases small peptides containing tyrosine or tryptophan residue. (auth)

35371 THE EFFECT OF WHOLE-BODY GAMMA IRRADIATION ON THE DEOXYCYTIDYLATE, DEOXYADENOSINE, AND DEOXYGUANOSINE DEAMINASE ACTIVITY OF RAT SPLEEN AND THYMUS. Jay S. Roth, M. Wagner, and M. Koths (Univ. of Connecticut, Storrs). Radiation Res., 22: 722-29(Aug. 1964).

A micromethod for the determination of deaminase activity was developed. The method depends on the Conway diffusion technique and may be applied to a few milligrams of tissue. The effect of 1000 R of whole-body γ irradiation on the activity of deoxycytidylate, deoxyguanosine, and deoxyadenosine deaminase of thymus and of the latter two enzymes in spleen was determined. In thymus, deoxycytidylate deaminase activity disappeared 16 to 18 hours postirradiation. Deoxyguanosine deaminase was increased 10%, and deoxyadenosine deaminase decreased by about 27%. In view of thymus involution, this represents a decrease in total enzyme of 10% and 47%, respectively. Deoxyguanosine and deoxyadenosine deaminase in spleen increased by 69% and 60%, respectively, 18 hours after irradiation. As the involution in spleen in this period amounted to 60%, these changes suggest that 1000 R of γ irradiation has no effect on these enzymes under the conditions described, and no deoxyadenosine or deoxyguanosine deaminase activity is lost on spleen involution. (auth)

35372 THE ELIMINATION OF CHROMOSOME ABERRATIONS IN LIVER CELLS BY CELL DIVISION. Howard J. Curtis, John Tilley, and Cathryn Crowley (Brookhaven National Lab., Upton, N. Y.). Radiation Res., 22: 730-4 (Aug. 1964). (BNL-7535)

Chromosome aberrations were scored in regenerating liver cells in mice after a large single dose of x rays and with and without repeated doses of CCl_4 which stimulates cell division in the liver. The purpose of the experiment was to assess the role of cell division in the elimination of chromosome aberrations. It is concluded that it may take four or more cell divisions before an aberration produced by x rays is eliminated from liver cells. This is not rapid enough to account for the elimination of chromosome aberrations induced in liver by x irradiation. It is concluded that there is healing of broken chromosomes in interphase nuclei; small breaks or latent breaks can be healed quickly severe breaks can heal over a period of months without cell division, and very severe breaks such as those caused by neutrons are apparently never healed. (auth)

35373 QUANTITATIVE RADIATION BIOLOGY—AN IMPORTANT BRANCH OF FUNDAMENTAL RESEARCH. K. G. Zimmer (Universität, Heidelberg and Kernforschungszentrum, Karlsruhe, Ger.). Therapie Monats, 13: 102-15 (1963). (KFK-179) (In German)

Basic problems in quantitative radiation biology are reviewed. The general directions of the studies being made at the Karlsruhe Institut für Strahlenbiologie are indicated, with emphasis being on the study of the physiochemical mechanism for the effects of radiation on biological material. The peculiarities of biological radiation damage are reviewed. The structure of hereditary cells and the radiodamage to them are discussed, with emphasis on bacteriophages. The use of radar waves for the spectrophotometric determination of free radicals in nucleic acids before and after irradiation is described. The modification of radiation effects by the addition of pharmaceuticals is another area of investigation. (J.S.R.)

35374 INFLUENCE OF IONIZING IRRADIATION ON THE CONTENT OF VITAMIN A IN WHALE LIVER. N. I. Egorov. Tr. Vses. Nauchn.-Issled. Inst. Morsk. Rybn. Khoz. i Okeanogr., 45: 95-106(1962). (In Russian)

The storage of fin and sperm whale livers at −30°C does not suppress all biochemical processes. Irradiation with γ doses of 2.5×10^6 R destroyed about 7% of the vitamin A content of fin whale liver and 6.9 to 17.6% of sperm whale livers. Storage of fin whale liver reduced the amount of vitamin A in both irradiated and nonirradiated samples with a stronger breakdown in irradiated liver. During the storage of sperm whale liver the amount of vitamin A increased, however the increase was slower in irradiated samples. Moreover, at 20° the process is more intense than at 0°. Irradiation of sperm whale liver with 0.6, 0.9, 1.5, and 2.0 MR breaks down the vitamin A; the stronger the dose the more considerable the breakdown. (R.V.J.)

35375 MORTALITY OF SENSITIZED RABBITS AFTER X IRRADIATION. A. D'Addabbo, U. Feine, and E. Kallee (Universität, Tubingen, Ger.). Z. Naturforsch., 19b: 483-7 (June 1964). (In German)

Whole-body irradiation with lethal or sublethal x ray doses caused more frequent and earlier deaths in hyperimmune rabbits than in non-sensitized controls. (auth)

35376 DIFFERENTIAL DIAGNOSIS: THOROTRAST DAMAGE. J. Dietrich and H. J. Hommel (Universität, Leipsig). Zentr. Neurochir., 24: 94-100(1963).

Two cases of paravasal Thorotrast-granulomas within the neck region leading to paresis of the recurrent nerve and swallowing disturbances led to diagnostic misinterpretation. For that reason this kind of cranial nerve lesion, not generally known, was again pointed out. (Excerpta Med., Sept. 23, 1: No. 7, July 1964)

35377 THE GENETIC EFFECTS OF X-IRRADIATION AND HYDRATION ON SEED AND POLLEN OF TOMATO. Nathan Shapiro. Thesis, Lafayette, Ind., Purdue Univ., 1963. 128p.

Multiple heterozygote F1 tomato seed were subjected to various desiccation and hydration treatments prior to irradiation. Wild-type pollen was treated at two temperatures and subjected to five moisture treatments and five x-ray dosages. Pollen treated as above was stored dry for one day before pollination. An attempt was made to detect radiation damage in pollen using fluorescence of callose in pollen grains and tubes and assays of sugars and ninhydrin positive compounds in ungerminated and germinated pollen. Dry tomato seed x rayed with 7500 R and one-half-hour hydrated seed treated with 30,000 R both showed high seed germination and ability to produce surviving R_1 seedlings. Hydrated seed treated with 30,000 R was less damaged than dry seed treated with 7500 R. The effects of x rays on the frequency of mutations in hydrated pollen indicate that seed set was decreased with an increase in dose and treated dry pollen set less seed than treated moist pollen. Stored hydrated pollen produced less seed than non-stored hydrated pollen. The percent germination of the R_1 seed produced

from pollinations with dry pollen was lower than that produced by hydrated pollen. Dry pollen treated at 0°C yielded more offtypes than hydrated pollen. Pollen fertility of the R_1 plants was shown to decrease as a result of dry pollen irradiation both at 25 and 0°C. Dry pollen treatments yielded a high percentage of R_2 families segregating for mutations at 25°C; at 0°C, there was little difference between dry and moist pollen treatments. No difference in the ability of callose to fluoresce was noted in the control and the dry pollen samples irradiated with 2,000–70,000 R. Paper chromatograms of ungerminated pollen showed the presence of one sugar and five ninhydrin positive compounds. Pollen germinated for 2 and 7 hours, showed an increase in sugars but not in ninhydrin positive compounds with increased time of pollen germination. In another series of pollen germination experiments, total nitrogen activity increased with an increase in time of germination after dry and moist pollen was treated with 500 R and germinated 1, 2, or 3 hours. (A.G.W.)

35378 THE EFFECT OF GAMMA RADIATION ON HOST-PARASITOID RELATIONSHIPS. Esam Ahmed Elbadry. Thesis, Berkeley, Calif., Univ. of California, 1963. 100p.

This investigation was designed to test the possible effect of gamma radiation on host-parasitoid relationships, and to explore the possibility of using parasitoids as indicators of non-symptomatic pathological conditions induced in a host by sublethal dosages of gamma rays. The experimental animals selected for this work included the potato tuberworm, Gnorimoschema operculella Zeller, as the host insect and three species of its internal parasitoids. The host insect decreases in radiosensitivity as the immature stages progress in development. Eggs and newly hatched larvae tolerated up to 9,000 R while older stages became more resistant and fully developed pupae required 50,000 R to prevent adult emergence. Host larvae resulting from irradiated eggs (3 days old) were of smaller size, lighter weight, and stored less fat tissue on which the egg-larval parasitoid Copidosoma koehleri Blanchard normally subsists during its embryonic stage. Consequently, these parasitoids showed typical symptoms of nutritional diseases. Influence of the irradiated host on the larval-parasitoid Macrocentrus ancylivorus Rohwer was shown by the prolongation of the larval developmental period and by increased mortalities of adults that were unable to emerge from the cocoons. The idea of using the parasitoid as an indicator of its host's pathological condition proved to be valid. The direct effect of low dosages on both the host and parasitoid while they are intimately associated was studied. Dosages between 500 and 2,000 R caused a pathological condition to the polygerm stage of Copidosoma. Embryos grew to abnormally large size and many of these failed to complete the embryonic development. Macrocentrus when subjected to low dosages at the second larval stage showed many symptoms of injury at the adult stage. The egg-parasitoid, Trichogramma semifumatum (Perkins), lacking any intimate physiological relationship with a live host, was not materially affected by dosages heavy enough to cause host mortality. (A.G.W.)

35379 THE DUMPY LOCUS IN INDUCED MOSAICS OF DROSOPHILA MELANOGASTER. Jack Lester King. Thesis, Berkeley, Calif., Univ. of California, 1963. 69p.

Certain alleles of the gene dumpy produce changes in the configuration of the dorsal surface of the thorax and in the distribution of thoracic bristles and cell hairs, termed vortices. X-ray induction of somatic crossing over was used to produce mosaic patches, which were homozygous for dumpy and homozygous or hemizygous for yellow on a heterozygous wild type background. Thirteen mosaics, including eight of recessive lethal alleles, were recovered from an estimated 7,000 treated individuals. In the mosaic specimens the dumpy recessives are non-autonomous: homozygous recessive patches bring about the vortex pattern in the adjacent heterozygous or possibly homozygous dominant tissue, and, in three cases, in the heterozygous tissue of the opposite side of the thorax. The doubling of bristles in the vortices is shown to be an indirect effect, since it sometimes occurs in the background tissue. It is suggested that the wild type allele of dumpy, in response to specific developmental environments, regulates the production of a supracellular factor which in turn affects tissue movement; and that the recessive alleles fail to regulate this production, which leads to abnormal tissue movement. The relationship between tissue movement and cellular determination in morphogenesis is discussed. It is concluded that dumpy is not a prepattern gene with respect to the distribution of thoracic bristles, since it does not have any effect on the determination of bristle organs. The differentiation of doubled bristles, however, is due to a change in the cellular environment which is indirectly brought about by dumpy; in this minor respect dumpy can be considered a prepattern gene. (Dissertation Abstr., 24: No. 12, Pt. I (June 1964))

35380 THE DEVELOPMENT OF CROSS SECTION PARALYSIS IN RABBITS AFTER HIGH DOSE IRRADIATION OF THE THORACAL MARROW. G. R. Bejenke. Thesis, Munich, Universität, 1962. 17p. $2.00(Gmelin, AED-DISS. 62-695). (In German)

Rabbits were irradiated with fractionated doses of 16 to 20 kR using 200-kv x rays. An increase of nerve sensitivity was observed directly after irradiation. After a time delay of 16 days on the average, the first paralytical symptoms were observed. The mean survival time for 20,000 R was 25 days. (Gmelin Inst.)

35381 UNTERSUCHUNGEN ÜBER DEN EINFLUSS VON UV-STRAHLEN AUF DEN STOFFWECHSEL VON PENICILLIUM CAMEMBERTI VARIANS CANDIDUM. (Investigation of the Effects of UV Radiation on the Metabolism of Penicillium Camemberti Variation Candidum). Lutz Grossner. Thesis, Berlin, Technische Universität, 1963. 51p.

The effect of UV radiation on the metabolism of Penicillium camemberti var. candidum was followed by respiratory measurements and determination of the CO_2 fixation. The latter represents a simpler criterium for the radiation effect occurring than the measurement of the respiration processes. The exceptional increase of the serine activity at low UV doses emphasizes that the radiation effect was detected not in the total cell metabolism but first of all in selective individual metabolic processes. (tr-auth)

35382 RADIOACTIVITY OF SOME ROCKS, SOILS, PLANTS, AND BONES. Ernest Marsden (Dominion Physical Lab., N. Z.). p.807-24 of "The Natural Radiation Environment." Chicago, University of Chicago Press, 1964.

Data on the α radioactivity of phosphate rocks used in fertilizer, fertilized soils, bones of sheep raised on fertilized areas, wheat, plankton, shellfish, etc., are reviewed. The case of Niue, an isolated South Pacific island (19° S 170° W), is considered in detail. The radioactivity of soils, foodstuffs, and water supply on Niue is discussed. Possible radiation effects on the population are considered, and it is concluded that the results to date point to a definite radia-

tion effect on Niue, probably due to ingested α-emitting foodstuffs rather than to external γ radiation. (D.L.C.)

35383 RADIATION AND OTHER ENVIRONMENTAL FACTORS IN HUMAN BIOLOGY. R. Lowry Dobson (World Health Organization, Geneva). p.1011-20 of "The Natural Radiation Environment." Chicago, University of Chicago Press, 1964.

A general discussion is presented on environmental factors in the evolution of man. The nature of life vs inanimate material is considered. Genetic variation is an important factor in enabling man to adjust to environmental changes. It is conjectured that before man evolved as such, his mutations were produced by the potassium-40 in his body which was taken from the sea. Today, most of man's spontaneous mutations cannot be accounted for by natural radiation. The need for more research on the genetic effects of radiation, chemicals, and other agents is emphasized. (D.L.C.)

Radiation Effects Therapy and Countermeasures

35384 (JPRS-25633) THE RADIOPROTECTIVE SUBSTANCES — CONCERNING CHEMICAL PROTECTORS. Akaboshi Sanya. Translated from Yakugaku Zasshi, 83: 1005-15(1963). 18p. (TT-64-31905)

Literature on radioprotective compounds and on chemical radiation protection in mammals is reviewed. Chemical protectors are classified, and their synthesis is discussed. (H.M.G.)

35385 (JPRS-25703) STUDIES IN RADIOPROTECTIVE ACTION OF GASES. Translated from Tsitologiya, 6: No. 2, 162-7; 222-5(1964). 19p. (TT-64-31975)

Two papers are included. Separate abstracts were prepared for each. (H.M.G.)

For abstracts of individual papers see: 35386 and 35387.

35386 (JPRS-25703(p.1-10)) NATURE OF ANTIRADIATION EFFECT OF INERT GASES AND LOW-MOLECULAR NARCOTICS. I. INFLUENCE OF MONATOMIC GASES AND LOW-MOLECULAR NARCOTICS UPON CYTOGENETIC EFFECT OF X-RAY IRRADIATION. V. P. Paribok and G. F. Krupnova. Translated from Tsitologiya, 6: 162-7(1964).

A quantitative comparison was made of the radioprotective effects of gaseous and non-gaseous narcotics. Vicia faba sprouts were x-irradiated on the 6th day of growth with doses ranging from 0 to 400 R. Chromosomal aberrations in cells of the root meristem were used as the criterion of radiation damage. Low-molecular narcotics, added to air, decreased oxygen-dependent radiation damage of cell. The protective action of low-molecular narcotics depended on the molecular volume, decreasing as the molecular volume increased. Two hypotheses are offered to explain the observed phenomena: persorption and diffusion. (H.M.G.)

35387 (JPRS-25703(p.11-18)) NATURE OF ANTIRADIATION EFFECT ON INERT GASES AND LOW-MOLECULAR NARCOTICS. II. INFLUENCE OF COLD AND KCN ON ANTIRADIATION EFFECT OF COMPRESSED NITROGEN. V. S. Kal'nii (Kal'niy) and V. P. Paribok. Translated from Tsitologiya, 6: 222-5(1964).

The lowering of temperature to +2° or a 30 min treatment with KCN suppressed the radioprotective action of compressed nitrogen on bean sprouts. It was shown that one of the causes of loss of radioprotective effects in nitrogen under these conditions is the depression of oxygen consumption and corresponding increase in its cellular consumption. The protective effectiveness of compressed nitrogen decreased with increase in oxygen concentration. (auth)

35388 IMPORTANCE FOR RADIO-PROTECTION OF THE REACTION OF CELLS TO SULPHYDRYL AND DISULPHIDE COMPOUNDS. Z. M. Bacq (Université, Liege) and Peter Alexander. Nature, 203: 162-4(July 11, 1964).

The mechanism of the protective effects of sulfhydrylan and disulfide compounds against radiation in biological systems is reviewed. It is believed that the mechanism of protection of mammals at the molecular level involves interaction of SH groups with radicals and that processes such as instantaneous repair of the primary lesion by hydrogen transfer are ultimately responsible for the observed increase in radioresistance. The SH groups responsible for such reactions are, however, not necessarily directly related to the protective agent that has been injected. (P.C.H.)

35389 MODIFICATION OF THE RADIATION EFFECT ON ASCITIC TUMOR CELLS BY PHARMACOLOGICAL AGENTS INJECTED INTRAVENOUSLY. José N. Correa and J. Robert Andrews (National Cancer Inst., Bethesda, Md.). Nature, 203: 200-1(July 11, 1964).

Experiments are reported in which intravenous injection of pharmacological agents (nitrogen mustard, AET plus glutathione, and BUdR) utilized physiologic processes in tumor-bearing mice to transport the pharmacological agent to the site of the tumor (ascitic P-388 murine lymphocytic leukemia of the DBA/2JN strain). Modifications of the effect of gamma radiation on the tumor cells was measured quantitatively by changes in radiation survival curve parameters. Survival points following treatment with BUdR as well as low doses of nitrogen mustard did not deviate significantly from the control curve. No cytotoxic effects were demonstrated due to the drug alone. At higher doses of nitrogen mustard, the survival points are at lower levels than the control curve but do not indicate a significant change in slope, suggesting an additive effect. The survival points obtained after irradiation of the cells treated with AET and glutathione indicated a protective effect. (H.M.G.)

35390 EFFECT OF ESTRADIOL ON BONE MARROW TRANSPLANTATION IN LETHALLY IRRADIATED MICE. John S. Thompson, Richard W. Reilly, Henry P. Russe, and Attallah Kappas (Univ. of Chicago). Nature, 203: 265-7 (July 18, 1964).

The effects of pharmacological amounts of estradiol, administered to lethally irradiated mice receiving both syngenic and allogenic bone marrow and to adult mice serving as bone marrow donors to lethally irradiated allogenic hosts are described. Female C3H/Anf and C57B1/6 mice were used both as donor and host. Within 4 hrs of lethal x irradiation, bone marrow cell suspensions were injected intravenously. Estradiol and testosterone solutions were injected subcutaneously three times a week during the treatment schedules. A daily record of animal death was maintained and expressed as percentage survival on any given day following irradiation. Results indicate that estradiol shortened the survival of lethally irradiated C3H/Anf mice given allogenic C57B1/6 bone marrow. The pattern of accelerated death was even more clearly evident in C3H/Anf mice given syngenic C3H/Anf bone marrow. Accelerated mortality of lethally irradiated C3H/Anf mice when donor bone marrow was obtained from

C57B1/6 mice that had been treated with estradiol for one or four weeks was also demonstrated. The experiments revealed an early pattern of death compatible with a primary failure of the transplanted cells to establish a successful graft when exposed to estradiol before or after transplantation. It was suggested that estradiol destroyed leukocytes or their precursors and/or impaired the proliferation of leukocytic stem cells. (H.M.G.)

35391 RADIATION PROTECTION OF PLANT CELLS. III. PROTECTIVE ACTION OF VARIOUS SUBSTANCES BEFORE AND AFTER EXPOSURE TO α RAYS. R. Biebl and W. Url (Universität, Vienna). Protoplasma, 56: 670-700(1963).

Onion coat epidermis of Allium cepa is well suited for studying the α-ray effect on plant cells and the influence of various chemical substances on the effect of exposure to α rays. A distinction should be made between chemical radiation protection in the stricter sense in the case of pretreatment and therapeutic effect in the case of after-treatment. Preparations of ^{210}Po served as α emitters. The intensities of the preparations ranged between 25 and 95 μC. Distance from the irradiated object 3 mm. For irradiation the sections were placed on filter paper impregnated with water, or with the solutions used for the pretreatment. The epidermis strips were covered during irradiation from the 2 small sides for one-third on either side and only the middle third was exposed to irradiation. Thus, in each section there were 2 nonirradiated controls, which, however, were perfectly comparable so far as the physiological condition of the cells and the treatment are concerned. The sensitivity to α rays of onion coat epidermis increases from the outer coat (1st coat) toward the center of the onion. Other physiological differences between the individual coats are pointed out. The experiments were made almost exclusively with the 2nd, living, fleshy coat. The inner, morphologically upper, epidermis of the onion coats, which can be stripped, is little suitable for tests of long duration, on account of its brief life and the necessity of a plasmolysis as life test, but also in the 24-hour test pretreatments with various chemical substances, especially with thioacetamide, already show patent protective effects. The solutions were applied in hypotonic concentrations (mostly 0.25 mol). For prolonged tests the outer, morphologically lower epidermis of the coats of red onions is very suitable. In this epidermis cellular death can be easily recognized by the escape of antokyan and the resultant bleaching of the dead cells. The surviving cells were counted or estimated in % of the total count. The longevity of the outer epidermis permits prolonged observations up to 18 days and more. In the case of pretreatment for 1 hr 0.25 mol thioacetamide and 0.25 mol thiourea showed the best protective effects. Patent protective effects were also exerted, however, by S-β-amino-ethylisothiourea 2 HBr (AET), methylallylisothiourea and methylthiourea, urea and tetramethylthiourea, as well as sodium azide and sodium thioglycolate. After-treatment for 1 hr with thioacetamide and thiourea not only had no protective effect, but even provoked an accelerated death of the cells as compared to untreated control sections irradiated on water. After-treatment with urea for 1 hr also remained without protective effect, but, possibly on account of the lower toxicity of urea, it did not cause a premature death either. It is assumed that in the case of these substances which acquire protective properties by pretreatment one is dealing with an actual "chemical radiation protection," which sets in at the moment of irradiation and by which the radiochemical degradation and conversion products of the water resulting from it, are partly rendered harmless. A second group is formed by those substances which are capable of reducing the harmful effect of exposure to α rays on the plant cells not by pretreatment but by after-treatment. They include glucose, fructose, saccharose, glycerin, pentaerythrol and $CaCl_2$. These substances, acting in the case of after-treatment, interfere only in the reaction which has been induced by the irradiation and which in untreated cells eventually leads to death. It is assumed that these substances are especially capable of retarding or checking colloid-chemical changes in the condition of protein, of impeding permeability changes in limiting layers of the plasma, of increasing retention and, in the case of prolonged exposure, occasionally even of permitting a "cure" of the radiation lesion. Reference is made to analogous effects of "chemical protective substances" against lesions induced by cold and heat and to the possibility of similar modes of action. When cells protected by chemical substances still die prematurely as compared to untreated irradiated control sections, this is attributed to late effects on the part of the cell nucleus damaged by direct hits. (Excerpta Med., Sect. 23, 1: No. 7, July 1964)

35392 AUTORADIOGRAPHIC DISTRIBUTION AFTER MEDICATION OF THE PROTECTIVE SUBSTANCE β AMINOETHYLISOTHIURONIUM HYDROBROMIDE (AET-S^{35}). E. Brodersen. Thesis, Hamburg, Universität, 1963. 34p. $2.00(Gmelin, AED-DISS. 63-474). (In German)

Sulfur-35-labeled AET was administered to 34 female young rats at 150 mg/kg. After 30 min, the heads of 24 rats were irradiated with 100, 500, or 1000 R (70 R/min). Activities in liver, heart, and kidneys were determined by autoradiography. The liver is the most radioactive organ. The distribution of AET-^{35}S in the kidneys was changed by the head irradiation. At all times a higher activity compared to the controls was measured. An excessive activity increase in the tubuli was observed. (Gmelin Inst.)

35393 AUTORADIOGRAPHIC DISTRIBUTION AFTER ADMINISTRATION OF THE S^{35} LABELED PROTECTIVE SUBSTANCE β-AMINOETHYLISOTHIURONIUM HYDROBROMIDE. E. Fetter. Thesis, Hamburg, Universität, 1963. 26p. $2.00(Gmelin, AED-DISS. 63-473). (In German)

The density of autoradiographs of the distal third of the lower jaw of 26 growing female rats was determined 1, 2, 5, and 24 hr after intraperitoneal injection of 150 mg/kg AET ^{35}S. The heads of 8 rats were irradiated with 100 or 1000 R 30 min after administration. The highest activity was found in the coronal incisor pulp and in bone tissue. This is not altered after irradiation with 100 or 1000 R. Head irradiation results in an increase of the activity after 1 to 2 hr. (Gmelin Inst.)

35394 RADIATION PROTECTION OF BACTERIAL SPORES AND SPORE GERMINATION. Gerald Darwin Kuhn. Thesis, Lafayette, Ind., Purdue Univ., 1963. 123p.

Radiation protection gained from colloidal sol or gel structures and glucose and sucrose was examined. The data show that by reducing or blocking free radical diffusion in the intercellular solvent system with a colloidal gel structure the inactivation coefficients of the irradiated bacterial spores were greatly reduced. While this offers a partially effective protective system against radiation in respect to undesirable induced reactions in vitro and in vivo, it also indicates that the majority of the inactivation was initiated outside of the spores. Likewise, it appeared that the protection obtained with a colloidal sol

structure and glucose was related to reduced diffusion properties brought about by the increased viscosity. Radiation protective effects of aqueous sugar solutions and sugar-gel systems were studied under low-flux-rate radiation conditions. Neither the type of radiation nor the radiation flux rate influenced the bactericidal effect of radiation with buffered spore suspensions. But the flux rate indirectly influenced the bactericidal effect of radiation on spores in aqueous sugar, in colloidal gel structures, and in sugar-gel systems. The protective role of sugars might arise from their reducing properties and/or radiation derivatives and subsequent preferential reactions with free radicals. The data indicate that the degree of radiation protection was increased by raising the sugar concentrations. Likewise, it appeared that the protection gained from glucose was superior to that from sucrose, particularly in gelled structures. In this system intracellular protection might occur more readily with glucose than with sucrose. The effects of distilled water and phosphate buffer storage menstruums and subsequent heat shocking in glucose solutions upon germination viability of B. stearothermophilus were studied. The effects of glucose osmosensitivity and enriched plating media and temperatures upon germination viability were investigated. (A.G.W.)

Radiation Hazards and Protection

35395 (NP-14210) QUARTERLY PROGRESS REPORT NO. 52, JULY 15, 1964. (Chicago. Univ. Air Force Radiation Lab.). Contract AF41(609)-1693. 106p.

Separate abstracts were prepared for eight sections of this report covering the evaluation of various chemical radioprotective compounds. (C.H.)

For abstracts of individual papers see: 35314, 35315, 35316, 35396, 35397, 35398, 35399, and 35400.

35396 (NP-14210(p.25-33)) STUDIES ON THE TOXICITY AND MECHANISM OF ACTION OF 2-MERCAPTOETHYLAMINE. Kei-Ming Yam and Bernard E. Hietbrink (Chicago. Univ. Air Force Radiation Lab.).

The influence of various chemical agents on the radioprotective activity, the physiological effects, and the acute toxicity of 2-mercaptoethylamine (MEA) was investigated in rats. The radioprotective effect of MEA on adrenal-demedullated female rats was studied. The results of studies on the influence of ergotamine tartrate on the MEA-induced increase in blood sugar levels of the female rat and the effect of pentobarbital on the acute toxicity of MEA are also presented. (C.H.)

35397 (NP-14210(p.34-47)) THE INFLUENCE OF VARIOUS CHEMICAL COMPOUNDS ON RADIATION LETHALITY IN MICE. V. J. Plzak, M. Root, and J. Doull (Chicago. Univ. Air Force Radiation Lab.).

Fourteen compounds were evaluated for protective activity against radiation lethality in CF_1 male mice. Of these, all but three were significantly radioprotective against a lethal dose of whole-body x irradiation as evidenced by the fact that 10% or more of the mice so pretreated survived for at least 30 days after the exposure. The best protection was afforded by the use of PD-31, 2-methyl-2-thiopseudourea monohydrobromide, where 70% and 80% of the animals survived. Three of the derivatives: PD-36, 2-(2-methoxyethyl)-2-thiopseudourea monohydrobromide; PD-39, 2-(2-hydroxyethyl)-2-thiopseudourea monohydrobromide; and PD-66, 4'-(1,4-dihydro-2-mercapto-4,4,6-trimethyl-1-primidinyl)acetophenone, protected 30% of the mice. Five of the derivatives: PD-22, 5-benzylidene-2-phenyl-imino-4-thiazolidinone; PD-25, 5-amino-1,3,4-thiadiazole-2-thiol; PD-58, 6-ethoxy-2-mercaptobenzothiazole; PD-70, N-(8-amino-1-anthraquinonyl) anthranilic acid; and PD-101, p-dimethylaminobenzene-thiol protected 20% of the mice. The final two compounds which exhibited activity were PD-20, 5-(p-dimethylaminobenzylidene) rhodanine, and PD-73, N,N'-bis(2-methoxyethyl) dithiooxamide, both of which allowed 10% of the mice to survive the lethal dose for 30 days after exposure. (auth)

35398 (NP-14210(p.48-54)) STUDIES ON TISSUE OXYGEN LEVELS AND RADIOPROTECTION WITH ANOXIA AND SEROTONIN IN MICE. A. T. Hasegawa and H. D. Landahl (Chicago. Univ. Air Force Radiation Lab.).

Injection of serotonin (90 mgm/kgm) reduced the oxygen tension levels in the spleen and vena cava of mice to about one-half of normal values. Forcing the mouse to breathe 4.6% oxygen reduced the oxygen tension in the spleen and vena cava to about 0.1 of normal. The combination of serotonin and anoxia reduced the oxygen tension in the spleen and vena cava to 0.10 and 0.06 respectively. The radiation dose reduction factor calculated from the survival data showed that the factor for the serotonin-treated animals was 1.7, and that for normal mice irradiated in 4.6% oxygen was 2.2, whereas the combination of serotonin and 4.6% oxygen gave a factor of 3. (auth)

35399 (NP-14210(p.55-80)) STUDIES ON THE TOXIC AND RADIOPROTECTIVE EFFECTS OF CYCLOBUTANE DERIVATIVES. J. Doull and V. Plzak (Chicago. Univ. Air Force Radiation Lab.).

The acute toxicity and radioprotective activity of various cyclobutane derivatives given intraperitoneally to mice were evaluated. The effect of several of these derivatives on the whole-body oxygen consumption and splenic oxygen tension of mice, the influence of high pressure oxygen and hypoxia during x ray exposure on the radioprotective activity of these agents, and preliminary experiments to define the pharmacologic profile of the cyclobutane derivatives in intact anesthetized animals are reported. (C.H.)

35400 (NP-14210(p.90-104)) HEMATOLOGICAL AND HISTOPATHOLOGICAL FINDINGS IN THE TISSUES OF MICE FED DIETS CONTAINING PARA-AMINOPROPIOPHENONE AND THE EFFECT OF DAILY X-RAY EXPOSURE ON THESE FINDINGS. D. Vesselinovitch, A. Sandberg, J. Doull, F. Fitch, and J. Meskauskas (Chicago. Univ. Air Force Radiation Lab.).

Gross and microscopic examinations were made of the hematopoietic tissues of CF_1 female mice fed a diet containing 0.1% PAPP and exposed to the effects of 100 R x irradiation per day. Hematological findings are also reported. Moderate to marked atrophy of the lymphoid tissue in the spleen, thymus, and lymph nodes was observed in all mice exposed to 100 R/day of x ray with or without the addition of PAPP to the diet. Hypocellularity of the bone marrow was also seen in all x irradiated animals regardless of the treatment with the radioprotective chemical. The addition of PAPP to the diet of unirradiated mice for a six-week experimental period resulted in a decrease in the red cell count and hematocrit at one week with a slight increase for the duration of the experimental period and a marked elevation in the white blood cell count which is probably due at least in part to an increased production of normoblasts at one week with a decrease throughout the remainder of the six-week period. In the animals fed PAPP marked erythroblastic hyperplasia and congestion of the

spleen was observed. Thymus, lymph nodes, and bone marrow hypercellularity was present in mice fed PAPP and sacrificed at 7, 13, and 28 days. The addition of PAPP to the diet of mice which received 100 R/day x ray did not protect against the marked decrease in white blood cells and produced a marked decrease in red blood cells. The addition of PAPP to the diet of mice produces a hemolytic anemia within one week of treatment as demonstrated by red and white blood cell counts, hematocrit determination, reticulocyte counts, hemoglobin determination, and the presence of Heinz bodies. (auth)

35401 IS GENETIC RADIATION PROTECTION POSSIBLE? H. A. Kuenkel (Universität, Hamburg). Atompraxis, 10: 301-5(July 1964). (In German)

The various hypotheses in regard to the effective mechanism of chemical radioprotective substances admit (in contrast to previous views) the possibility that direct radiation effects, e.g., radioinduced point mutations, can also be influenced by so-called protective substances. Extensive genetic experiments with Drosophila melanogaster and also with Bacterium coli have shown that application of cysteine and also of serotonin before irradiation reduces the induction of mutations. On the other hand, the compound aminoethylisothiuronium (AET), which is known to be especially effective against somatic radiation damage, caused a significant increase in the radioinduced mutation rate. (auth)

35402 CURRENT CONCEPTS IN RADIATION PROTECTION. PART II. RADIOIODINE INTAKE, 1961-1962. Luther L. Terry (Public Health Service, Washington, D. C.) and Donald R. Chadwick. J. Am. Med. Assoc., 188: 343-50 (Apr. 27, 1964).

Data were accumulated on average daily ^{131}I concentrations/l of composited milk in areas monitored by the Federal-State Pasteurized Milk Network during the 1961 and 1962 periods of atmospheric nuclear testing, and estimates of ^{131}I dosages to the thyroid gland of infants consuming such milk were made. With three exceptions, all the 12-mo doses were below the Radiation Protection Guide recommended by the Federal Radiation Council for normal peacetime operations of nuclear industry. Because of wide variation of ^{131}I in milk from different herds, some children probably received somewhat higher doses. The National Advisory Committee on Radiation has studied various countermeasures for reducing ^{131}I exposure, and the FRC has reported on health effects. (Publ. Health Eng. Abstr.)

35403 ON THE ACTUAL LEVEL OF CLEARANCE OF INHALED RADIOISOTOPES FROM THE RESPIRATORY TRACT AND THE TOTAL ORGANISM. I. Schmidtke (Universität, Freiburg i. B.). [Zentr. Biol. Aerosol Forsch., 11: 420-31(Feb. 1964)]. (In German)

A literature survey was made of the data presently available on the absorption and clearance of inhaled radioisotopes from the respiratory tract and the total organism. The substances tested as aids in excretion are tabulated. 120 references. (J.S.R.)

35404 RADIATION SAFETY IN THE AREA OF MEDICAL PRACTICE (PROTECTION AGAINST INJURY BY IONIZING RADIATION). R. Wittenzellner (Institut fur Strahlenschutzkunde, Munich). p.152-7 of "Atomstrahlung in Medizin und Technik." Munich, Verlag Karl Thiemig KG, 1964. (In German)

The factors that must be considered in devising adequate but not onerous radiation shields are indicated. Medical-biological radiation protection includes prophylaxis, diagnosis, and therapy of radiation injury. The first-aid measures necessary in case of exposure are summarized. Radiation protection in x-ray diagnosis is described as a typical example of the radiation shielding requirements for radiodiagnosis. (J.S.R.)

35405 TISSUE DOSE DUE TO NEUTRONS OF COSMIC-RAY ORIGIN. C. R. Hill and D. S. Woodhead (Royal Cancer Hospital, Surrey, Eng.). p.449-61 of "The Natural Radiation Environment." Chicago, University of Chicago Press, 1964.

Some of the apparent difficulties in estimating tissue dose to man due to cosmic-ray neutrons are discussed. Progress is reported on an experimental program of measurements of this tissue dose. The tissue-equivalent proportional counter of the Hurst type was studied; the error due to α contamination was found to be significant. On the basis of the few measurements, the actual dose rates may be less than 25 mrem/yr. (D.L.C.)

35406 THE RADIATION HAZARD TO WORKERS USING TRITIATED LUMINOUS COMPOUNDS. H. G. Jones and B. E. Lambert (Radiological Protection Service, Belmont, Surrey, Eng.). Vienna, International Atomic Energy Agency, 1964, Preprint SM-52/21, 14p. (CONF-448-16)

From IAEA Symposium of the Assessment of Radioactive Body Burdens in Man, Heidelberg, May 1964.

The traditional radioactive constituent of luminous compounds has been radium, a substance of potentially great hazard. In recent years, suitable alternatives to radium have been sought and encouragement has been given to the use of tritiated compounds. The urine of users of these tritiated compounds was analyzed and complementary measurements were made of tritium in air. The stability of the compounds themselves was also investigated. Interpretation of the results in complicated because the ICRP recommends two different maximum permissible body burdens for tritiated water, 2 mC and 1 mC. The corresponding concentrations of tritium in urine, assuming the body to contain 4.3×10^4 ml of water, are 4.7×10^{-2} and 2.3×10^{-2} μC/ml respectively. Employees at four major factories were found to have tritium in their urine, one person attaining a concentration of over six times the lower maximum permissible level. A number of operators at two factories had concentrations of 1 to 2 times the maximum permissible level. The main hazard appears to be due to the inhalation of tritiated water vapor when the compound is mixed with its solvent and adhesive. A new test for the stability of the compounds in moist air was devised. Under the conditions of the test, the two compounds in major use lose 0.1 and 0.5% of their tritium respectively in the first 2.5 hours, mainly as tritiated water. The biological half-life of the tritiated water in two luminizers was found to be 12.1 and 13.4 days respectively, which is in reasonable agreement with the 12 days assumed by ICRP. The significance of these results are discussed. (auth)

35407 INFLUENCE OF AEROSOL PROPERTIES AND RESPIRATORY PATTERN UPON HAZARDS EVALUATION FOLLOWING EXPOSURE BY INHALATION. R. G. Thomas (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.). Vienna, International Atomic Energy Agency, 1964, Preprint SM-52/40, 18p. (CONF-448-19)

From IAEA Symposium of the Assessment of Radioactive Body Burdens in Man, Heidelberg, May 1964.

There are three important biological parameters which are necessary in evaluating the hazards from compounds entering the body by any route. These are the amount deposited in the body, the distribution and translocation kinetics within the body, and the rate of excretion of the

material. Sufficient quantitative data on these points are generally lacking in the case of an accidental exposure. Experimental animal studies correlating different physical and chemical characteristics of inhaled particles with the three biological variables mentioned above are described. Values for the amount and location of deposited material as a function of the particle size inhaled are presented for a tissue soluble compound (cesium chloride) and for a tissue insoluble compound (thorium chloride). Evidence is given to substantiate the variations which occur in tissue distribution and excretion of an element, depending upon its physical and chemical state when breathed. Data from experiments with aerosols of many compounds, including those already mentioned, are used to show a unique correlation between body burden and fecal excretion during the first few post-exposure days. The advantages in performing analyses on both urine and feces for bioassay purposes are demonstrated. The fallacies in current methods of practical hazard assessment from air sampling and bioassay techniques are stressed throughout, using the above data as examples. (auth)

Radiotherapy and Radiodiagnosis

Refer also to abstracts 35896 and 35897.

35408 (TID-7678) DYNAMIC CLINICAL STUDIES WITH RADIOISOTOPES. Proceedings of a Symposium held at the Oak Ridge Institute of Nuclear Studies, October 21-25, 1963. 3rd AEC Symposium Series. Ralph M. Kniseley and W. Newlon Tauxe, eds. (Oak Ridge Inst. of Nuclear Studies, Inc., Tenn.). June 1964. 658p.

Separate abstracts were prepared for twenty-three papers included in this report. Four papers were abstracted previously and appeared in NSA Vol. 18 as nos. 7993, 8631, 11622, and 13416. (C.H.)

For abstracts of individual papers see: 35276, 35277, 35278, 35279, 35280, 35319, 35409, 35410, 35411, 35412, 35413, 35414, 35415, 35416, 35417, 35418, 35419, 35420, 35421, 35422, 35423, 35424, and 35425.

35409 (TID-7678(p.107-33)) RESPIRATION STUDIES OF SUBSTRATE OXIDATION IN MAN. Bert M. Tolbert (Colorado. Univ., Boulder); and Frank J. Cozzetto (Colorado. Univ., Denver. School of Medicine).

The current status of one nondestructive method used to study intermediary metabolism in patients is reviewed. The method uses the rate of catabolism and respiration of $^{14}CO_2$ from substrates labeled in specific positions with ^{14}C. The basic concept of this method is that catabolic rates are controlled by the dynamics of intermediary metabolism and physiology, and if one measures the rates of $^{14}CO_2$ respiration from a sufficient variety of labeled substrates it is possible to define rather clearly and quantitatively the relative importance of the major metabolic pathways in a given patient. In practice, a selected rate study with a given substrate can give information on a specific metabolic process. Examples include information on the Krebs' citric acid cycle obtained from a study of the conversion of acetate-1-^{14}C to $^{14}CO_2$ and information on the relative importance of the pentose phosphate pathway vs. the Embden Myerhoff pathway in glucose utilization obtained from studies of glucose-1-^{14}C, glucose-6-^{14}C, and uniformly labeled glucose-^{14}C catabolism to $^{14}CO_2$. The experimental basis of the techniques is discussed. Instrumentation and the use of a digitized system for computer calculations in data analysis are described and radiation hazards to patients are considered. Results are reported from ^{14}C studies in humans for the assessment of steatorrhea, an impaired fat absorption phenomena; lactase deficiency, an impaired absorption phenomena; folic acid and vitamin B_{12} deficiency, an impaired metabolic process; obesity, a metabolic abnormality; galactosemia, a congenital metabolic abnormality; and the effects in rats of acetazoleamide, a potent carbonic anhydrose inhibiting drug. (59 references.) (C.H.)

35410 (TID-7678(p.153-69)) CEREBRAL BLOOD FLOW MEASURED WITH RADIOISOTOPES. Louis Sokoloff (National Inst. of Mental Health, Bethesda, Md.).

Techniques using radioisotopes for measuring cerebral blood flow which are based on the Fick principle are described. A brief review of the theory, procedure, and limitations of the nitrous oxide technique is presented as a basis for discussions of the radioisotope methods that are modifications or extensions of this technique. A mathematical formula is included for blood-flow determination by the nitrous oxide technique. Modifications of the technique using ^{79}Kr, ^{85}Kr, or ^{131}I-4-iodoantipyrine as tracers for the continuous measurement of total or local cerebral blood flow are described. Diagnostic applications are discussed briefly. (12 references.) (C.H.)

35411 (TID-7678(p.135-52)) CEREBRAL AND CEPHALIC BLOOD FLOW IN MAN: BASIC CONSIDERATIONS OF THE INDICATOR-FRACTIONATION TECHNIQUE. Leo A. Sapirstein and Lincoln E. Moses (Stanford Univ., Calif. School of Medicine).

The theory of the indicator-fractionation technique for blood-flow measurements and the mathematical analysis of data are discussed. Applications of the technique in the measurement of cerebral and noncerebral cephalic blood flow in man, using ^{42}K or ^{131}I-iodoantipyrine as tracers, are described. Results in 23 normal subjects indicated that 16.8% of the cardiac output perfused the head, including the brain. The results were slightly lower than those obtained with the nitrous oxide technique. It is suggested that the radioisotope technique may offer valuable aid in the diagnosis, prognosis, and therapy of cerebrovascular disease. 7 references. (C.H.)

35412 (TID-7678(p.171-88)) CLINICAL EVALUATION OF RADIOISOTOPE RHEOENCEPHALOGRAPHY. Cesare Fieschi (Genoa. Universita. Facolta di Medicina).

Applications of radioisotope rheoencephalography in the measurement of total cerebral blood flow; the measurement of rapid changes in cerebral blood flow in order to follow the time pattern of the response to pharmacological agents, to hypercapnia, to hypoxia, to tilting, and to digital compression of the carotid artery; the measurement of regional changes in blood flow in the brain; and the development of simple techniques suitable to clinical purposes are discussed. Results are reported for more than 200 patients, 140 of whom had ischemic brain lesions in the area of carotid distribution, in whom blood circulation was studied by scintillation counting after the injection of ^{131}I-albumin or ^{131}I-paraaminohippurate into the carotid artery. 25 references. (C.H.)

35413 (TID-7678(p.189-212)) REGIONAL BLOOD-FLOW MEASUREMENTS WITH KRYPTON-85 AND XENON-133. Henry N. Wagner, Jr. (Johns Hopkins Univ., Baltimore. School of Medicine).

The use of the radioactive noble gases, ^{85}Kr and ^{133}Xe, as tracers for the measurement of regional blood flow is

discussed. It is pointed out that for most purposes the two gases can be used interchangeably although there are certain important differences in their γ energy, half-life, and physiological behavior. Results are reported from animal studies and clinical studies of ^{133}Xe clearance from the brain, ^{133}Xe and ^{85}Kr hepatic clearance, the clearance of ^{85}Kr and ^{133}Xe from human forearm muscle, the clearance of ^{85}Kr and ^{133}Xe from the heart, and measurements of simultaneous clearance of ^{85}Kr and ^{133}Xe from various organs. Diagnostic applications of the technique are discussed. (5 references.) (C.H.)

35414 (TID-7678(p.213-36)) PULMONARY FUNCTION STUDIES WITH O^{15}, C^{11}, AND N^{13}. John B. West (Hammersmith Hospital. Postgraduate Medical School, London).

Properties of ^{15}O, ^{11}C, and ^{13}N that influence their use as tracers in pulmonary function studies are reviewed. It is pointed out that all require a beam of deuterons, most conveniently provided by a cyclotron, for their production and that, because of their short half-lives, all are best produced by a continuous-flow process whereby gas is pumped through a target box on which the deuteron beam falls. The radioactive gas then flows to an adjacent chemistry laboratory where it is incorporated into various compounds, such as CO_2, CO, and H_2O, and pumped to the clinical laboratory where the compounds must be used immediately. The technique for measuring regional blood flow and ventilation in the human lung by scintillation counting after the inhalation of $C^{15}O_2$ is described, the uptake of $C^{15}O_2$ is compared with that of $^{11}CO_2$ in the lung, and data are presented from measurements of the absorption of inhaled $H_2{}^{15}O$ vapor and animal studies using the 3 radioisotopes as tracers. Applications in the diagnosis of localized lung diseases are discussed. 5 references. (C.H.)

35415 (TID-7678(p.237-47)) USE OF XENON-133 IN STUDYING THE VENTILATION AND PERFUSION OF THE LUNG. D. V. Bates, Wilmot C. Ball, Jr., and A. C. Bryan (Royal Victoria Hospital, Montreal and Montreal Children's Hospital).

Radioactive xenon is a unique tool for the study of ventilation and perfusion in the lung, and it can be easily used long distances from the place where it is made. The proportional distribution of gas and blood to different lung zones can be accurately plotted; their variation can be studied under conditions of rest and exercise; and deviations found in different lung diseases can be measured. Tests can be performed with a very low radiation dose to the patient, the whole investigation giving an exposure of about 50 mrads. The close correspondence between results obtained by the use of radioactive CO_2 and ^{133}Xe should reinforce the data obtained by both these techniques since the sources of error are quite different for each isotope. (C.H.)

35416 (TID-7678(p.249-66)) RADIOPULMONARY CARDIOGRAPHY FOR MEASUREMENT OF CENTRAL MEAN TRANSIT TIME AND ITS ARTERIAL AND VENOUS SUBDIVISIONS. DeLores E. Johnson, C. K. Liu, Mehmet M. Akcay, and George V. Taplin (Los Angeles County Harbor General Hospital, Torrance, Calif. and California. Univ., Los Angeles. School of Medicine. Lab. of Nuclear Medicine and Radiation Biology).

A dual-tracer technique is described for measuring the arterial and venous subdivisions of the pulmonary circulation separately by registering an ^{125}I lung dilution curve simultaneously with an ^{131}I radiocardiogram. In normal subjects the venous division is slightly larger than its arterial counterpart. In congestive heart failure the venous fraction is increased, whereas in pulmonary hypertension it is reduced. The ratio of pulmonary mean transit time to cardiac output appears to be a sensitive index to myocardial efficiency. Results are included from measurements in 10 healthy controls and 12 patients with specific cardiovascular and pulmonary lesions. (C.H.)

35417 (TID-7678(p.267-83)) QUANTITATIVE RADIOCARDIOGRAPHY FOR THE MEASUREMENT OF PULMONARY BLOOD VOLUME. Luigi Donato, Carlo Giuntini, Romano Bianchi, and Attilio Maseri (Pisa, Italy. Universita. Centro di Medicina Nucleare).

The cardiopulmonary circulation is schematized as a sequence of five vascular sections, the four heart chambers and the pulmonary circulation. For each section a frequency function of transit times through the section is described. This is visualized as the curve that would be recorded at the outflow of the section after a single sudden bolus of indicator has entered the section. A mean distribution time, T, (mean transit time) is defined, which equals the volume-to-flow ratio in the section and which is called the turnover time of the section. For certain types of flow pattern, for instance, if uniform instantaneous mixing occurs in the section, the entire distribution of transit times will be univocally defined for a given T value and will correspond to a monoexponential function. The relations between the mean transit times of the concentration curves obtained at various points and the turnover times of mean circulation times of the various sections were analyzed using radiocardiography and computer analysis of data. Applications of the method for the evaluation of cardiopulmonary hemodynamics in normal and pathological radiocardiograms obtained after the injection of ^{131}I-serum albumin are reported. (C.H.)

35418 (TID-7678(p.285-317)) HEPATIC BLOOD-FLOW AND RETICULOENDOTHELIAL-SYSTEM STUDIES WITH RADIOCOLLOIDS. G. V. Taplin, E. K. Dore, and D. E. Johnson (California. Univ., Los Angeles. School of Medicine. Lab. of Nuclear Medicine and Radiation Biology and Los Angeles County Harbor General Hospital, Torrance, Calif.).

Radioisotope techniques developed in the past 10 years give the physician new tools for the diagnosis and management of patients with hepatobiliary disease. The colloid blood-disappearance test for liver blood flow is certainly an improvement over the bromsulfalein clearance procedure, which requires hepatic-vein catheterization. The ratio of the radioactive rose bengal and colloid blood-disappearance rates permits accurate evaluation of polygonal cell function when there is associated impairment of hepatic blood flow. Results of both procedures can be useful in the management of cirrhotic patients before and after portacaval shunt operations. Photoscans of the liver and spleen, together with tracer tests of phagocytic and digestive functions of the RES, give valuable clues to many difficult diagnostic problems. Current radioisotope procedures are reviewed and clinical results are reported. (C.H.)

35419 (TID-7678(p.319-57)) LIVER FUNCTION MEASURED BY THE BLOOD CLEARANCE OF ROSE BENGAL-I^{131}: A REVIEW AND A MODEL BASED ON COMPARTMENTAL ANALYSIS OF CHANGES IN ARM, BLOOD, AND LIVER RADIOACTIVITY. C. C. Lushbaugh (Los Alamos Scientific Lab., N. Mex.); Arthur Kretchmar, and William Gibbs (Oak Ridge Inst. of Nuclear Studies, Inc., Tenn.). (LADC-6403)

After almost 40 years of research and development, during 10 years of which radioactive tracers have been used, the clearance of dyes from the blood by the liver remains an incompletely solved and only moderately well-understood

phenomenon. The basic mechanism by which the hepatic cell binds the dye and thereby clears the blood or by which the dye is diverted into extrahepatic routes of excretion in the presence of disease are the most poorly understood and the least investigated problems. This review supports the opinion of most investigators in this field that much remains to be done on this problem; the underlying mechanisms of hepatic dye binding, vascular transport, and extrahepatic vascular extraction need further investigation, particularly at the cellular and molecular levels; further technical modification or variants of the rose bengal (RB)–^{131}I liver-function test are unnecessary and superfluous; and the use of RB–^{131}I clinically is warranted on the basis of the physiologic mechanisms of its excretion but, because of the widespread disagreement in preferred methods of measurement and the resulting difficulties in interpretation and clinical correlation, its clinical laboratory use will most likely continue to wane. 203 references. (auth)

35420 (TID-7678(p.359-82)) MEASUREMENT OF HEPATIC BLOOD FLOW. Sheila Sherlock (Royal Free Hospital, London).

Methods of measuring liver blood flow in man are described. These include methods dependent on hepatocellular function, methods dependent on reticulo-endothelial cell activity, and methods dependent on physical principles such as thermocouples or local dilution techniques. The use of radioisotope-labeled dyes, albumins, and colloids alone or together with unlabeled dyes as tracers, hepatic vein and cardiac catheterization, and external and internal counting methods for the measurement of total or segmented hepatic blood flow are discussed. Applications of the methods for use in normal livers and in patients with cirrhosis are evaluated. 31 references. (C.H.)

35421 (TID-7678(p.383-410)) THE ISOTOPE RENOGRAM AS A TEST OF RENAL FUNCTION. W. Newlon Tauxe, Frank T. Maher, and James C. Hunt (Mayo Clinic, Rochester, Minn.).

Applications of isotope renograms in the assessment of renal function are reviewed. Techniques are described that use ^{131}I-ortho-iodohippurate and external counting for the kinetic analysis of renal function. Use of the method for the identification of those hypertensive patients, potentially curable by surgery, whose disease is derived from renal ischemia caused by renal-artery stenosis is discussed. Samples of renograms from normal subjects and patients with renal-artery stenosis are presented. The use of ^{131}I-diatrizoate as a substitute for inulin in the measurement of glomerular filtration by the continuous-infusion technique is also discussed briefly. 18 references. (C.H.)

35422 (TID-7678(p.411)) DIFFERENTIAL RENAL FUNCTION AS MEASURED BY MERCURY-197 NEOHYDRIN UPTAKE AND SCAN. Bruce Sodee (Walter Reed Army Medical Center, Washington, D. C.).

The use of external counting of the uptake of ^{197}Hg-neohydrin by the kidneys as a differential renal function test is discussed briefly. (C.H.)

35423 (TID-7678(p.433-43)) DISTRIBUTION AND METABOLIC RATES OF LIVER-PRODUCED PLASMA PROTEINS IN MAN. A. S. McFarlane (Gt. Brit. National Inst. for Medical Research, London).

Methods are discussed for the determination of conditions involving metabolic unbalance in which synthesis rates do not equal catabolic rates. Emphasis is placed on the use of ^{131}I and ^{14}C as tracers in studies on the distribution and metabolic rates of liver-produced plasma proteins in man. 23 references. (C.H.)

35424 (TID-7678(p.473-95)) STUDIES WITH INSULIN-I^{131}. Rosalyn S. Yalow and Solomon A. Berson (Veterans Administration Hospital, New York).

The metabolism and distribution of ^{131}I-insulin, the antigenicity of insulin in man and animals, and the use of the reaction of ^{131}I-insulin with specific antibody in the determination of plasma insulin levels are discussed. The relation of insulin destruction and adult diabetes is reviewed. Results are reported from studies of the time course of disappearance of protein-precipitable radioactivity from plasma following the intravenous administration of ^{131}I-insulin that showed a slow disappearance of protein-bound radioactivity from the plasma of insulin-treated diabetics and schizophrenics and a rapid removal of ^{131}I-insulin from the plasma of untreated normal and diabetic subjects. The prolonged retention of insulin in the circulation of insulin-treated subjects was shown to be a result of the formation of insulin-binding antibodies. Data are included from studies on the species specificity of the insulin-antibody reaction, the nature of the antigenicity of insulin in man, and the use of ^{131}I-insulin to determine plasma insulin concentrations in adult and juvenile diabetic subjects before and after overnight fasting and a 100-g oral glucose tolerance test. Applications of results in the diagnosis and evaluation of diabetes are discussed. 38 references. (C.H.)

35425 (TID-7678(p.537-63)) IRON TURNOVER IN MAN. David C. Price (Toronto General Hospital and Brookhaven National Lab., Upton, N. Y.).

Applications of ^{59}Fe as a tracer in studies of Fe metabolism in man are reviewed. A general outline is presented of current data on normal human Fe turnover, including Fe absorption with its various controlling factors, the normal body content and distribution of Fe, and Fe excretion as measured both by chemical balance methods and by tracer techniques. Results are reported from whole-body measurements of ^{59}Fe turnover in normal man, and in patients with physiologic and pathological Fe absorption and excretion. The complexities involved in the extrapolation of whole-body tracer data to quantitative Fe kinetics are discussed. 144 references. (C.H.)

35426 (TID-20916) STUDY OF THE HEMODYNAMIC CHARACTERISTICS OF THE PULMONARY CIRCULATION AND THE LEFT HEART BY MEANS OF RADIOCARDIOGRAPHY. Annual Summary Report. Gabriele Monasterio and Luigi Donato (Pisa, Italy. Universita. Centro di Medicina Nucleare). July 20, 1964. Contract AT(30-1)-2648. 22p.

Methods were developed for the evaluation of left heart blood volume and of the transfer function across the pulmonary circulation from radiocardiograms made after the administration of ^{131}I-serum albumin or ^{131}I-hippuran. The possibility of measuring the pulmonary blood volume in man from radiocardiograms without catheterizing the left heart was investigated. (C.H.)

35427 LYMPH NODE RESPONSE TO HIGH-DOSE INTRALYMPHATIC INJECTION OF RADIOCHROMIC PHOSPHATE. R. H. Burger (New York Medical Coll., New York). Bull. N. Y. Acad. Med., 40: 142-7(1964).

Direct intralymphatic injection of radioactive chromic phosphate particles is a simple, convenient way of delivering tremendous doses of strong β radiation to a series of localized lymph nodes draining a local area. The doses and volumes of isotope employed can saturate and destroy nodal tissue proximal to the site of injection. Radioactive $Cr^{32}PO_4$ particulates are very susceptible to entrapment by and remain in the lymph node long enough to exert their

therapeutic effect. More studies are in progress to determine if this technique is applicable in humans for prophylactic and therapeutic radiation of lymph nodes proximal to penile, testicular, renal, and other cancers before, during, or after surgical extirpation of the primary tumor. (Excerpta Med., Sect. 23, 1: No. 7, July 1964)

35428 NEW METHOD OF SURGICAL TREATMENT OF CANCER OF THE LUNG WITH ADMINISTRATION OF ROENTGEN-RADIUM THERAPY DURING OPERATION. I. T. Shevchenko. Diseases Chest, 45: 36-9(1964).

The method of radium–roentgen surgery of cancer of the lung suggested, not only extends the relapseless period of the disease, but also has these advantages: it considerably reduces the periods of special and combined treatment of the patient; the patient more easily tolerates the radiation load during the operation than before and after the operation; contact therapy produces a greater antiblastic effect. Clinical observations are being collected. In addition to the generally accepted criteria for evaluating the effectiveness of any method of treatment with regard to long-term survival, data on the development of relapses and metastases within short periods of time are also of essential importance. The immediate results of radium–roentgen surgery of cancer of the lung warrant its recommendation for introduction into practice. (Excerpta Med., Sect. 23, 1: No. 7, July 1964)

35429 RADIUM APPARATUS FOR INTRA-ORAL USE IN TOOTHLESS PATIENTS. C. Dazzi and P. U. Gennari (Universita, Parma, Italy). Radiobiol. Radiotherap. Fis. Med., 18: 204-13(1963).

A description is given of the technique of construction of modeled apparatus in acrylic resin for the treatment of tumors of the endentulous jaw. An attempt was made to standardize the construction of several types of apparatus and describe a device for holding the radium that is fixed to the palate by means of traction between the cranium and the jaw. (Excerpta Med., Sect. 23, 1: No. 7, July 1964)

35430 PROBLEMS OF DOSAGE IN THE TREATMENT OF CORPUS CARCINOMA WITH Co^{60} BEADS. E. Kuhn (Medical Univ., Pecs, Hungary). Zentr. Gynaekol., 86: 63-8(1964).

This is a consideration of the difficulties of dosage in intrauterine irradiation by radiocobalt beads, basing measurements made in the bladder and rectum by means of the Siemens-Gammameter. Fixed dosage in mgh per hour is the source of serious errors: The time of exposure is assessed according to individual treatment, depending on the intensity of irradiation measured in the bladder or in the rectum, as well as on the irradiation tolerance of these organs. The amount of irradiation of the neighboring organs can be reckoned according to the dosage of the endometrium and myometrium. Among the women so far treated there have been neither recurrences nor irradiation damage. The greater part of this work was carried out in the Oncoradiological Institute of the General Hospital of Budapest. (Excerpta Med., Sect. 23, 1: No. 7, July 1964)

35431 NON-METABOLIC USES OF β-RADIATION IN RADIOTHERAPY. J. Dutreix (Institut G. Roussy, Villejuif, France). p.39-46 of "Atomstrahlung in Medizin und Technik." Munich, Verlag Karl Thiemig KG, 1964. (In German)

A discussion of the general problems of the dosimetry of β radiation from sources of small dimensions introduced practical examples of the non-metabolic uses of β radiation. The examples given were ^{32}P uses in skin therapy, functional disturbance of the hypophysis by implantation of ^{90}Y beads, and the use of Y needles. (J.S.R.)

35432 DESIGN OF MEDICAL RADIATION FACILITIES. Thomas Jaeger (Kernforschungsanlage, Julich, Ger.). p.190-8 of "Atomstrahlung in Medizin und Technik." Munich, Verlag Karl Thiemig KG, 1964. (In German)

Shield designs for isolated teletherapy areas (specifically γ therapy) are discussed in order to show the problems involved in the construction of therapy rooms. The unresolved problems of shielding for scattered radiation and photon recoil and the shielding effectiveness of observation windows are considered. (J.S.R.)

35433 SCANNING OF THE BONE MARROW IN HEMATOPOIETIC DISORDERS. R. M. Kniseley, G. A. Andrews, C. L. Edwards, and R. Tanida (Oak Ridge Inst. of Nuclear Studies, Tenn.). Vienna, International Atomic Energy Agency, 1964, Preprint SM-51/55, 17p. (CONF-453-9)

From IAEA Symposium on Medical Radioisotope Scanning, Athens, Apr. 1964.

Scanning can help evaluate size and distribution of the hematopoietic marrow, a difficult task by aspiration or biopsy. With the 61-hole focusing gold–tungsten Oak Ridge National Laboratory Scanner, the marrow organ has been clearly delineated by means of intravenous colloidal ^{198}Au, it being known that reticulo-endothelial function in the marrow correlates with areas of hematopoiesis. Patients with normal hematopoiesis and with a variety of blood disorders such as focal marrow lesions, acute and chronic leukemia, polycythemia vera, myelofibrosis, multiple myeloma, and lymphoma were scanned. Because of the reticulo-endothelial activity in liver and spleen, the marrow pattern is obscured in the mid-trunk. Vertebral bodies, intervertebral discs, pelvis and long bones were outlined, and, in the thorax, the sternum and thoracic vertebrae. Focal lesions were also found. Because of respiratory motion, individual ribs were not seen. In expanded marrow, the knee region was shown, including the joint space. It was possible to correlate these scans with aspiration biopsy and with linear scans. Because relatively large doses of ^{198}Au are required, other isotopes are being investigated. An improved whole-body scanner is being tested for more practical scans. (auth)

35434 COMPOUNDS LABELLED WITH LOW-ENERGY GAMMA RAY EMITTERS FOR MEDICAL ISOTOPE SCANNING. K. E. Scheer, K. zum Winkel, and M. Georgi (Universität, Heidelberg). Vienna, International Atomic Energy Agency, 1964, Preprint SM-51/38, 30p. (CONF-453-11)

From IAEA Symposium on Medical Radioisotope Scanning, Athens, Apr. 1964.

Applications of low-energy gamma emitters for medical scintillation scanning are discussed. It is pointed out that the lead shielding of the collimators is much more effective, and multiple focusing thin-walled hole collimators can therefore be used, making possible a higher geometrical resolution and, therefore, the detection of smaller lesions. The absorption of the radiation within the body tissue limits the depth of visibility of lesions. In extended organs like the liver, the super-position of radiation originating from the back of the organ is avoided. This allows a better detection of more superficial lesions. The most important low-energy gamma-emitting nuclide is ^{125}I. For thyroid scanning, it is used in the form of iodide. A suitable compound for liver scanning is ^{125}I-labeled Rose Bengal. An alternative compound is ^{125}I-CAI (heat denatured albumin). For kidney scattering ^{125}I-Hippuran was found to be suitable when injected intramuscularly with hyaluronidase to ensure a uniform level of radioactivity in the kidneys. Another useful low-energy gamma-emitting nuclide for medical scanning is ^{197}Hg which may be used as chloride for kidney

and spleen scanning. Special precautions must be taken to avoid overlying of kidney and spleen. A higher quality scan is obtained with ^{197}Hg-labeled Neohydrin. This compound is also useful for brain tumor localization. Typical scans of thyroid, liver, spleen, kidney, and brain tumors obtained with low-energy gamma emitters and conventional nuclides and compounds are compared. (auth)

35435 EVALUATION OF FLUORINE-18 AS A SCANNING AGENT FOR INTRACRANIAL TUMORS. W. Entzian (Universität, Bonn), S. Aronow, A. H. Soloway, and W. H. Sweet. Vienna, International Atomic Energy Agency, 1964, Preprint SM-51/41, 17p. (CONF-453-12)

From IAEA Symposium on Medical Radioisotope Scanning, Athens, Apr. 1964.

Fluorine-18, a 110-minute half-life positron emitter, was studied as a possible agent for brain tumor localization. It was prepared in a nuclear reactor by thermal neutron irradiation of Li_2CO_3 (^{6}Li(n,α)^{3}H, ^{16}O(^{3}H,n)^{18}F). Tissue studies in mice bearing subcutaneously-transplanted ependymomas indicated that labeled sodium fluoride ($Na^{18}F$) gave excessive concentrations in bone and therefore was not suitable as a brain-scanning agent. However, labeled potassium fluoborate ($KB^{18}F_4$) showed good preferential uptake in tumor compared with brain, uptake ratios ranging from 8 to 11. No excessive concentrations were found in other organs both with mice and cats. Toxicity studies were carried out in mice and rabbits at levels of 300 mg/kg and 120 mg/kg respectively. No adverse effects were observed provided the solution was neutralized to a physiological pH. The chemical amounts needed for patient scanning were less than 0.5 mg/kg of body weight. A comparative clinical study of 10 patients, each scanned with $KB^{18}F_4$ and other isotopic agents, corroborated the findings that this is a useful compound for brain tumor localization. Intravenous injection was optimally performed 30 minutes prior to scanning at a dosage of 15 μC/kilogram of body weight. Tissue samples of tumor and normal brain were obtained from one patient at operation. The uptake ratio was 3.5. While this is lower than that found in the mouse, it is still in a useful range. Blood samples obtained from patients at varying time intervals after injection yielded a blood clearance curve which had two constants. The first was very rapid and the second slower. This sequence is typical of useful scanning agents. (auth)

35436 A DEPTH FOCUSING COLLIMATOR FOR THE INVESTIGATION OF THE CORTEX OF THE BRAIN. H. I. Glass (King's Coll. Hospital, London). Vienna, International Atomic Energy Agency, 1964, Preprint SM-51/27, 16p. (CONF-453-13)

From IAEA Symposium on Medical Radioisotope Scanning, Athens, Apr. 1964.

A detector is described which consists of a 5-in. diameter by 0.25-in. thick sodium iodide crystal and a depth-focusing collimator. The collimator was designed initially for use in brain cortical blood flow investigations using ^{133}Xe, but may be used with other soft gamma-emitting isotopes such as ^{125}I. The collimator, which is constructed of lead, is 0.25-in. thick and is of multichannel design. The focus is at 1.75 cm from the face of the collimator. The response in air to a point source on the central axis of the collimator falls to 10% of the maximum at ±0.75 cm from the focus. The far field response in tissue is considerably better than in air due to high tissue attenuation of the soft gamma radiation. The response of the collimator to a point source in air and inside a skull is presented. The collimator was used to measure local cortical blood flow in the brain using ^{133}Xe. However, using ^{125}I-tagged chemicals, the detection of cortical tumors and hemorrhages is possible using this apparatus. (auth)

35437 PHYSICAL, BIOLOGICAL, AND CLINICAL ASPECTS OF FAST NEUTRON AND OTHER HIGH LET RADIATIONS AND IMPLICATIONS FOR FAST NEUTRON BEAM CLINICAL RADIOTHERAPY. J. Robert Andrews (National Cancer Inst., Washington, D. C.). 51p. (CONF-456-4)

From 18th Annual Symposium on Fundamental Cancer Research and Cellular Radiation Biology, Houston, Tex., Mar. 1964.

The physical characteristics and biological effects of fast neutrons and other high LET radiations are reviewed. Applications of fast neutron beams in the radiotherapy of cancer are discussed. Results are reviewed for 226 patients with cancer of various anatomic sites, and generally very advanced in respect to extent and metastosis, irradiated with 0 to 19 Mev neutron energy spectrum fast neutrons. Normal and cancer tissue radiation responses associated with LET and oxygen effects are discussed. It is pointed out that changes of cellular recovery phenomena associated with high LET radiations should be carefully considered in respect to both the size and spacing of dose increments in human cancer radiotherapy. The development of high LET radiation sources for cancer radiotherapy is discussed. (72 references.) (C.H.)

CHEMISTRY

General

35438 ISOTOPE LABORATORY, INSTITUTE FOR PHYSICAL-CHEMISTRY, LAJOS KOSSUTH UNIVERSITY. I. SCIENTIFIC WORKS OF THE ESTABLISHMENT. Lajos Imre and Jazsef Nagy. Magy. Kem. Lapja, 14: 141-7(Mar. 1964). (In Hungarian)

Systematic work was started in the second half of 1961 with the aim to promote the study of Hungarian nuclear chemistry (principally reactor chemistry, chemistry of hot atoms, isotope chemistry, and applied radiochemistry) both in university education and in the whole field of the discipline by resolute development of research methods. The first stage of the long-range scientific work is chiefly characterized by consequent utilization of the principles of the classical and the irreversible thermodynamics as a natural consequence of the properties of transitory particle agglomerates detected. (auth)

35439 ISOTOPE LABORATORY OF THE INSTITUTE FOR PHYSICAL CHEMISTRY, LAJOS KOSSUTH UNIVERSITY. II. TECHNICAL EQUIPMENTS OF THE LABORATORY. Lajos Imre and Jozsef Nagy. Magy. Kem. Lapja, 19: 185-8(Apr. 1964). (In Hungarian)

The technical design of the laboratory is based on the requirement of being able to technically educate a certain number of students. In compliance with this lab working places of customary type have been provided. The layout of the rooms has been performed as to hinder any radioactive contamination from the hot booth to get to the measuring apartments or to the tracing lab either by personal communication or by water or air flow. The working mechanism of the air cleaning equipment made on the basis of Hungarian projects is an object of dosimetry research over the recording of automatic activity measuring instruments. (auth)

35440 THE CHEMISTRY OF NOBLE GAS COMPOUNDS. Herbert H. Hyman (Argonne National Lab., Ill.). Science, 145: 773-83(Aug. 21, 1964).

The synthesis of simple fluorides, oxyfluorides, oxides, and xenates, and perxenates is reviewed. Special attention is given to xenon compounds. 72 references are included. (P.C.H.)

35441 LOW-LEVEL RADIOACTIVE CONTAMINATION. Richard I. Weller (Franklin and Marshall Coll., Lancaster, Penna.). p.567-75 of "The Natural Radiation Environment." Chicago, University of Chicago Press, 1964.

Measurements are reported of the inherent radioactivity of elements and materials. Alpha, beta, and gamma activities of the samples, including a wide variety of Pb samples, were measured using a thin-window flow counter, an internal 4π flow counter, and a scintillation counter. The data are tabulated. (D.L.C.)

Analytical Procedures

Refer also to abstract 36565.

35442 (AERE-R-3840) THE ACCURATE DETERMINATION OF SMALL AMOUNTS OF NICKEL IN THE PRESENCE OF COPPER BY DIFFERENTIAL SPECTROPHOTOMETRY. A. R. Lister (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Sept. 1961. 17p.

The development of methods that enable small amounts (1 to 250 μg) nickel to be determined accurately in the presence of a thousand-fold excess of copper are described. After dissolution of the sample, copper is separated electrolytically and the nickel is then determined by differential or normal spectrophotometry as its 4-methylnioxime complex extracted into toluene. The use of the methods to analyse metallic powder mixes is briefly discussed. (auth)

35443 (AERE-R-4270) THE PRECISE DETERMINATION OF O/U RATIOS IN URANIUM DIOXIDE BY COMPARATIVE POLAROGRAPHY. H. I. Shalgosky, R. C. Smart, and J. Watling (United Kingdom Atomic Energy Authority. Research Group. Chemistry Div., Woolwich Outstation, England). June 1964. 11p.

The determination of U(VI) with a precision of 0.1% was achieved by comparative polarography using the differential cathode ray polarograph. The technique was applied to solutions of uranium dioxide in a phosphoric/sulfuric acid medium in order to determine the O/U ratio of the material. With samples having O/U ratios of 2.01 or higher the standard deviation of the method is ±0.0001. With samples having lower O/U ratios stringent precautions must be taken against oxidation. The standard deviation is then ±0.0002 at an O/U ratio of 2.001. (auth)

35444 (HW-77694) THE ION EXCHANGE-SPECTROGRAPHIC DETERMINATION OF STRONTIUM AND CALCIUM IN URANIUM. R. Ko (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 28, 1963. Contract AT(45-1)-1350. 7p.

An ion exchange-emission spectrographic method for the determination of calcium and strontium in uranium was developed. Uranium was removed by adsorption on Dowex 1 and calcium and strontium were determined by copper spark emission spectrographic analysis. One part of strontium and five parts of calcium in a million parts of uranium were determined with an estimated relative standard deviation of ±6%. (auth)

35445 (K-1524) DETERMINATION OF URANIUM IN ALUMINUM. G. S. Petit, J. E. McCall, and C. A. Kienberger (Oak Ridge Gaseous Diffusion Plant, Tenn.). Aug. 19, 1964. Contract W-7405-eng-26. 10p.

A short method has been developed for determining trace quantities of uranium in aluminum. The aluminum is dissolved in hydrochloric acid and the uranium is extracted into tri-n-octylphosphine oxide (TOPO) dissolved in benzene. The uranium is recovered with an ammonium oxalate solution, ammonium hydroxide is added, and the yellow uranium complex is developed with hydrogen peroxide. The absorbancy is measured on a spectrophotometer at 410 mμ and compared with that of a standard. The precision of a single analysis is ±8 percent of the value (100 to 500 ppm) at the 95 percent confidence level and there is no significant bias. An analysis can be made in 1.5 hours. (auth)

35446 (LA-2859) THE EFFECT OF GALLIUM ON PLUTONIUM ASSAY. K. S. Bergstresser and G. R. Waterbury (Los Alamos Scientific Lab., N. Mex.). Nov. 1962. Contract W-7405-eng-36. 19p.

In a general investigation of plutonium assay methods,

all of the methods gave essentially identical results except in the case of a few samples analyzed by a photometric titration method. Slightly low assay values were obtained for delta-stabilized plutonium containing gallium when a visible precipitate of lead sulfate formed during the titration. Evidently, a pretitration step involving reduction of the hydrochloric acid solution of the metal with a lead reductor occasionally introduced sufficient lead to form a precipitate when sulfuric acid was added prior to the titration of plutonium(III) with ceric sulfate. Omission of the pretitration step caused high assays. An extensive search for impurity elements in a sample of delta-stabilized plutonium revealed no interfering elements in concentrations that would have a noticeable effect on the assays. It was found that gallium(II), in variable, unknown quantities, was formed during dissolution of delta-stabilized plutonium in hydrochloric acid. The gallium(II) is titratable with ceric sulfate and causes a positive bias in the assay. Lead(II) ion in the lead reductor presumably oxidizes gallium(II) to the noninterfering (III) oxidation state. Evaporation of the hydrochloric acid solution of the metal to fumes with sulfuric acid and reduction with zinc amalgam also are effective in eliminating gallium(II) and provide a solution in which the plutonium is present quantitatively in the (III) oxidation state. By exercising care in the use of the lead reductor, or by using the fuming operation followed by reduction with zinc amalgam, precise and accurate assays of delta-stabilized plutonium containing gallium were obtained by the photometric titration method. (auth)

35447 (LA-3091) AN EVALUATION OF THE AMPEROMETRIC TITRATION OF PLUTONIUM. K. S. Bergstresser and G. R. Waterbury (Los Alamos Scientific Lab., N. Mex.). May 1964. Contract W-7405-eng-36. 18p.

The method of Seils, Meyer, and Larsen for determination of plutonium was evaluated under conditions selected for maximum reliability of the analytical results. For this investigation the analyses were made essentially as described in the published procedure except for a few minor modifications in equipment. Samples containing 10 to 20 milligrams of plutonium were converted to solutions in which the plutonium was present as a sulfate and which were free of interfering cations and anions. Quantitative formation of plutonium(VI) was accomplished by oxidation with argentic oxide; any excess of this reagent was destroyed by heating the plutonium solution to 80°C. After cooling and increasing the sulfuric acid concentration to 5 N, the plutonium was titrated amperometrically with ferrous sulfate. This titrant was standardized daily against potassium dichromate for the most precise determinations. It was found that under optimum conditions the method can be used for assays of plutonium in which the relative standard deviation will be no greater than 0.03 percent and the average error will be less than 0.03 percent. Investigation of the method also included a study of interference for thirty-one separate cations. (auth)

35448 (LA-3103) THE SPECTROPHOTOMETRIC DETERMINATION OF URANIUM USING ARSENAZO. A. L. Henicksman and A. D. Hues (Los Alamos Scientific Lab., N. Mex.). May 1964. Contract W-7405-eng-36. 19p.

The spectrophotometric method for the determination of uranium by use of arsenazo [3-(2-arsonophenylazo)-4,5-dihydroxy-2,7-naphthalenedisulfonic acid] has been critically evaluated over a wide concentration range. The addition of arsenazo to a sample solution buffered at a pH of 7.9 produces a maximum absorbance at 600 mμ. EDTA is used to mask the reactions of many common elements, and countermeasures are described for several elements not masked by EDTA. The method is applicable to 20 to 200 micrograms of uranium, and data are included showing that in this range the standard deviation for a single determination is 0.38 relative percent. With very simple changes the lower limit may be extended to 1 microgram with good precision. (auth)

35449 (LADC-5830) X-RAY FLUORESCENCE SPECTROGRAPHIC DETERMINATION OF ZIRCONIUM AND MOLYBDENUM IN THE PRESENCE OF URANIUM. E. A. Hakkila, R. G. Hurley, and G. R. Waterbury (Los Alamos Scientific Lab., N. Mex.). [1961]. Contract [W-7405-eng-36]. 13p. (CONF-285-8)

From the 7th Conference on Analytical Chemistry in Nuclear Technology, Gatlinburg, Tenn., Oct. 1963.

Zirconium and molybdenum in mixed uranium, zirconium, and molybdenum carbides were determined without chemical separation using an x-ray fluorescence spectrographic procedure. The mixed carbide is dissolved in nitric–hydrofluoric acid, niobium is added to serve as an internal standard, and the solution is irradiated using a tungsten-target x-ray tube. The ratios of the intensities of the Kα lines for zirconium and niobium and of the Kβ lines for molybdenum and niobium are measured. Corrections, which were found to be a linear function of uranium concentration in the range between 30 and 100% of uranium, are applied to each intensity ratio. The procedure is applicable to the determination of 5 to 50% each of zirconium and molybdenum with a relative standard deviation of 1 to 2%. Foreign elements of high mass absorption coefficient interfere when present in concentrations greater than approximately 10% for the determination of molybdenum, or 20% for the determination of zirconium. (auth)

35450 (ORNL-TM-922) THE ANALYSIS OF PROMETHIUM-147. J. A. Norris (Oak Ridge National Lab., Tenn.). Aug. 19, 1964. Contract W-7405-eng-26. 4p.

A sample of highly radioactive promethium-147 was analyzed spectroscopically for neodymium and samarium, at the request of the Isotope Division. The procedure used in this analysis is described, as is a special chamber designed and fabricated for use in carrying out the arc excitation of the sample. The promethium was found to contain 2% neodymium and 5% samarium. (auth)

35451 (PG-Report-390) ANALYTICAL METHOD FOR THE SPECTROGRAPHIC DETERMINATION OF ALUMINUM IN URANIUM ALLOYS. (United Kingdom Atomic Energy Authority. Production Group, Springfields, Lancs, England). 1964. 19p.

The sample is dissolved in acid and an aliquot passed through an anion exchange column. The aluminum is eluted with hydrochloric acid. The aluminum is concentrated by coprecipitation on ferric hydroxide, and after dissolution in hydrochloric acid the aluminum is determined by the rotating disc electrode technique using scandium for internal standard. The method is suitable for the determination of 50–2,000 ppm of aluminum in uranium alloys containing any one of the following elements up to the level stated: 10% iron, molybdenum, niobium, titanium, 5% chromium, 1% germanium, 0.6% silicon, 0.5% vanadium. (auth)

35452 (PG-Report-572) ANALYTICAL METHOD FOR THE ABSORPTIOMETRIC DETERMINATION OF MOLYBDENUM IN URANIUM COMPOUNDS AND URANYL NITRATE SOLUTION. (United Kingdom Atomic Energy Authority. Production Group, Springfields, Lancs, England). 1964. 6p.

A nitric acid solution of the sample is fumed with

sulfuric acid to remove the nitrate. The sulfate solution is made strongly acid with hydrochloric acid and the molybdenum determined absorptiometrically as the dithiol complex after extraction into carbon tetrachloride. The method is applicable to molybdenum contents of 5-50 ppm on uranium basis. The range may be extended up to 500 ppm by taking an aliquot of the solution before color development. (auth)

35453 (PG-Report-573) ANALYTICAL METHOD FOR THE VOLUMETRIC DETERMINATION OF BORON IN ZIRCONIUM DIBORIDE POWDER. (United Kingdom Atomic Energy Authority. Production Group, Springfield, Lancs, England). 1964. 8p.

The zirconium diboride is decomposed by fusion with sodium carbonate. The melt is water leached and filtered. If necessary other metal ions are removed from the filtrate by precipitation with barium carbonate. The boric acid in the filtrate is determined by titration with standard sodium hydroxide solution in the presence of mannitol. The method is applicable to the determination of boron in zirconium diboride of relatively high purity. (P.C.H.)

35454 (PG-Report-579) ANALYTICAL METHOD FOR THE DETERMINATION OF ZINC IN URANYL NITRATE SOLUTIONS, AMMONIUM DIURANATE, URANIUM OXIDES, URANIUM TETRAFLUORIDE AND URANIUM METAL. (United Kingdom Atomic Energy Authority. Production Group, Springfields, Lancs, England). 1964. 7p.

After removal of nickel as the dimethyl glyoxime complex, zinc is extracted as the dithizonate. Co-extracted metals and excess dithizone are removed with sodium sulfide and the zinc determined absorptiometrically. The method is applicable to samples containing 2-30 μg zinc in the portion taken for analysis. The following levels of impurities can be tolerated (μg) Fe 1000, Ni 500, Cu 30, Co 10, Pb 10. (P.C.H.)

35455 ANION EXCHANGE STUDY OF A NUMBER OF ELEMENTS IN NITRIC–HYDROFLUORIC ACID MIXTURES. ANALYTICAL APPLICATIONS OF THE SYSTEM. Edmund A. Huff (Argonne National Lab., Ill.). Anal. Chem., 36: 1921-3(Sept. 1964).

The behavior of 19 elements on a strong base anion exchange resin was studied at variable nitric (1 to 12N) and hydrofluoric (0.2 to 5N) acid mixture concentrations. Volume distribution coefficients were obtained by spectrographic analysis of column effluent fractions. The application of this system to the analysis of tantalum for trace impurities or for the determination of tantalum as a trace impurity in other matrices was demonstrated. (auth)

35456 EMISSION SPECTROGRAPHIC DETERMINATION OF AMERICIUM IN PLUTONIUM. Charles E. Pietri and Albert W. Wenzel (Atomic Energy Commission, New Brunswick, N. J.). Anal. Chem., 36: 1937-9(Sept. 1964).

A method is described in which americium is determined simultaneously with other impurities by emission spectrography after separation from plutonium by anion exchange in 8N nitric acid. Europium is used as an internal standard for americium while cobalt is used for the other impurity elements. The rate of burning of the sample during spectrographic excitation is controlled by the use of gallium oxide matrix. The relative standard deviation of the method for americium is less than 6% with a lower limit of detection of 0.03 μg. (P.C.H.)

35457 DETERMINATION OF LONG-LIVED IODINE-129 IN IRRADIATED GRAPHITE FUEL SYSTEMS. George Buzzelli (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Anal. Chem., 36: 1973-5(Sept. 1964).

Iodine-129, a long-lived fission product ($t_{1/2} = 1.6 \times 10^7$ years) in irradiated fuel particles and in fission-product trap material, was readily determined using neutron activation analysis. Natural monoisotopic iodide carrier is added to the sample and radiochemically separated using a solvent extraction technique. The separated iodide is neutron activated together with an ^{129}I standard and these are subsequently counted for ^{130}I ($t_{1/2} = 12.5$ hours). The chemical yield of the carrier is obtained via neutron activation of the iodide carrier. Fission ^{129}I is thus determined in irradiated fuel. The sensitivity of the method is at the nanogram level. (auth)

35458 SEPARATION AND SPECTROPHOTOMETRIC DETERMINATION OF TECHNETIUM IN FISSIUM. R. J. Meyer, R. D. Oldham, and R. P. Larsen (Argonne National Lab., Ill.). Anal. Chem., 36: 1975-9(Sept. 1964).

The process of distillation of technetium from sulfuric acid was studied and successfully applied to the separation of technetium from uranium, ruthenium, and a number of other fission elements. Technetium is determined by measuring the absorbance of its toluene–3,4-dithiol complex at 455 mμ. The complex is formed in 9N sulfuric acid in the presence of bromine and extracted into isoamyl acetate. In the analysis of uranium-fission element alloys relative standard deviations of 0.67 and 2.0% were obtained at the 0.030 and 0.0065% levels, respectively. (auth)

35459 SUBMICRODETERMINATION OF OXYGEN-18-BENZOPHENONE BY INFRARED SPECTROMETRY. Israel Laulicht and Shraga Pinchas (Weizmann Inst. of Science, Rehovoth, Israel). Anal. Chem., 36: 1980-1(Sept. 1964).

The ^{18}O-benzophenone content of 100 to 700-μg samples of 1 to 61 atom % enriched benzophenone can be determined with the mean accuracy of ±0.5% (absolute) from the infrared absorption intensity of their CCl_4 solutions at 1667 and 1637 cm^{-1}, the locations of the $C=^{16}O$ and $C=^{18}O$ stretching bands. No weighing of the sample is generally necessary since the ^{18}O content is calculated on the basis of the respective absorbances. It seems that this method can be used for the ^{18}O determination in submicro samples of water after reacting it with pure dichlorodiphenylmethane. (auth)

35460 DETERMINATION OF CESIUM AND RUBIDIUM AFTER EXTRACTION WITH 4-SEC-BUTYL-2(α-METHYLBENZYL)PHENOL. W. J. Ross and J. C. White (Oak Ridge National Lab., Tenn.). Anal. Chem., 36: 1998-2000(Sept. 1964).

Methods were developed for radiochemical and flame photometric determinations of cesium and rubidium. These elements are selectively extracted from basic tartrate solutions, after removal of the alkaline earth elements, with 1M solutions of 4-sec butyl–2(α–methylbenzyl)phenol (BAMBP) in cyclohexane. Cesium and rubidium can be measured directly in the organic solution or after being back-extracted into 1M HCl. (auth)

35461 SPECTROPHOTOMETRIC DETERMINATION OF RARE EARTH METALS WITH 4-(2-PYRIDYLAZO)-RESORCINOL. Kailash N. Munshi and Arun K. Dey (Univ. of Allahabad, India). Anal. Chem., 36: 2003-4(Sept. 1964).

4-(2-Pyridylazo)resorcinol reacts very sensitively with rare earth metals to form red colored complexes (λ_{max} 515 mμ) at pH 6.2. The molar ratio for all of the chelates is 1:2 (metal:reagent). Optimum conditions, including the range

of adherence to Beer's law, effect of pH on the color intensity, effect of excess reagent, sensitivity, and interferences from foreign ions, are described for the spectrophotometric determination of rare earth metals using 4-(2-pyridylazo)resorcinol as a reagent. (auth)

35462 SEPARATION AND SPECTROPHOTOMETRIC DETERMINATION OF SUBMILLIGRAM QUANTITIES OF ALUMINUM IN ALUMINUM–PLUTONIUM ALLOYS. H. B. Evans and Hiroshi Hashitani (Argonne National Lab., Ill.). Anal. Chem., 36: 2032-4(Sept. 1964).

An indirect spectrophotometric method is described for the determination of submilligram amounts of Al in Al–Pu alloys that is easily adapted to routine glove box and hood procedures. Recovery data for the method were obtained by carrying Al through the suggested ion exchange-precipitation procedure in the absence of Pu. The amount of Al was varied from 100 to 400 μg. The absorbances were measured at 360 to 390 mμ. The relative standard deviation was less than 2% over the various measured wavelengths. In the analysis of six Pu–Al samples, repeat an analyses on the same samples had a range of slightly less than 2 μg with a sample that contained approximately 200 μg of Al. (P.C.H.)

35463 DETERMINATION OF EUROPIUM(II) AND TOTAL EUROPIUM IN EUROPIUM-ACTIVATED LITHIUM IODIDE SCINTILLATION CRYSTALS. D. A. Costanzo (Oak Ridge National Lab., Tenn.). Anal. Chem., 36: 2042-4 (Sept. 1964).

A coulometric method using the platinum anode was used for the determination of Eu(II) and total Eu in LiI(Eu) single crystals with a relative error of −1 to −2% in the range 0.02 to 0.2 wt % Eu. The results for total Eu obtained by the coulometric method agreed with results obtained by the polarographic method, after the removal of iodide ion by cation exchange procedure, within the experimental relative error of the methods of 1 to 3%. The coulometric titration of Eu should be carried out in an acidic medium to prevent the hydrolysis of the Eu(II) and Eu(III), which would result in a loss in current efficiency for the oxidation electrolysis and longer reduction times, respectively. (P.C.H.)

35464 IMPROVED TECHNIQUES FOR ROUTINELY COUNTING LOW LEVELS OF TRITIUM AND KRYPTON-85. Mary L. Curtis and H. L. Rook (Monsanto Research Corp., Miamisburg, Ohio). Anal. Chem., 36: 2047-8(Sept. 1964).

Geiger and proportional counting for precisely and rapidly analyzing tritium in ^{3}He and ^{85}Kr in Xe are described. An analytical method for ^{85}Kr by gamma counting is also presented. The equipment and techniques described have proved to be fast and trouble free. One hour is required for a complete analysis with duplicate samples by Geiger or proportional counting. Gamma counting ^{85}Kr requires about 5 min per sample. (P.C.H.)

35465 DETERMINATION OF NIOBIUM IN ZIRCONIUM–NIOBIUM ALLOYS. D. F. Wood and M. R. Adams (Imperial Metal Industries (Kynoch) Ltd., Witton, Birmingham, Eng.). Anal. Chim. Acta, 31: 153-8(Aug. 1964).

A rapid control determination of niobium in 50% zirconium/50% niobium master-alloy is described; it is a direct spectrophotometric procedure, based on the reaction of niobium ions with hydrogen peroxide in concentrated sulfuric acid. The procedure is suitable for the examination of zirconium alloys containing niobium in the range 0.1 to about 60%. At least 1% of chromium, cobalt, copper, manganese, nickel, or tantalum, does not interfere. Interference due to optical absorption by the peroxy-complexes of titanium, tungsten, molybdenum, and vanadium is not significant in the determination of niobium above about 1%, provided that these metals are not in excess of about 0.5, 0.25, 0.1, and 0.02%, respectively. To compensate for optical absorption due to iron(III), a solution of the sample, not treated with peroxide, is used. (auth)

35466 THE SEPARATION OF COBALT, MANGANESE AND SODIUM BY ELECTROPHORETIC FOCUSSING OF IONS. R. Gijbels, L. De Meyer, and J. Hoste (Ghent Univ.). Anal. Chim. Acta, 31: 159-65(Aug. 1964).

Electrophoretic focussing of cobalt(II), manganese(II), and sodium(I) ions was investigated with EDTA as a complexing agent. Excellent separations of binary mixtures Co/Mn and Mn/Na are described, even for very unfavorable activity ratios. Separation of Co/Mn/Na is satisfactory only if the activities are of the same order of magnitude. (auth)

35467 THERMOGRAVIMETRIC INVESTIGATION OF MANGANESE(II), SILVER AND THORIUM DILITURATES. Milton W. Goheen and Rex J. Robinson (Univ. of Washington, Seattle). Anal. Chim. Acta, 31: 175-9(Aug. 1964).

Thermolysis curves for manganese(II), silver, and thorium diliturates were obtained. Manganese diliturate precipitated as the octahydrate and dehydrated in two steps. Silver diliturate formed as a monohydrate from aqueous solutions. Thorium diliturate formed as a hydrate containing 20 moles of water and dehydrated in two steps. Methods for the thermogravimetric determination of manganese(II) and thorium by precipitation as the diliturates are suggested. (auth)

35468 DETERMINATION OF SILICON IN THORIUM. S. R. Desai, H. Savitri, and M. S. Varde (Atomic Energy Establishment, Trombay, India). Anal. Chim. Acta, 31: 184-5(Aug. 1964).

A modification is suggested for the silicomolybdate blue method for the determination of silicon in thorium. EDTA is added to the sample solution before adjustment of the initial pH. The precipitate that forms after the addition of ammonium molybdate solution can then be redissolved by adding tartaric acid and raising the pH to 2.5. When once dissolved, the thorium molybdate can be kept in solution even at pH 1. The addition of EDTA has no effects on the absorbance of the silicomolybdate. (P.C.H.)

35469 THE MECHANISM OF ZIRCONIUM SORPTION FROM NITRIC ACID BY SILICA GEL. R. Caletka and M. Kyrs (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Rez). Collection Czech. Chem. Commun., 29: 1150-62(May 1964). (In German)

The sorption kinetics of low Zr concentration on silica gel from a nitric acid solution were investigated in dependence on the type of silica gel and the solution composition and the desorption kinetics of the zirconium from the silica gel as a function of the acidity of the solution from which the zirconium was adsorbed. The slowest of the sorption kinetics of the given processes is the formation of complex nitrates or hydrolyzed forms of Zr in the solution and the diffusion of the Zr particles through the grains of the adsorbent. The mechanism of the Zr sorption is probably different in the sorption from solutions of different acidity. (tr-auth)

35470 THE SEPARATION OF LANTHANONS BY PAPER PRECIPITATION CHROMATOGRAPHY WITH 8-QUINOLINOL. II. THE SEPARATION AND DETECTION OF LANTHANUM, CERIUM, PRASEODYMIUM AND URANIUM. Hideo Nagai (Kumamoto Univ., Japan). Bull. Chem. Soc. Japan, 37: 1076-8(July 1964).

A modified developer composed of a n-butyric acid solution and a water-miscible organic solvent was applied to the separation of ions from mixtures containing La, Ce(III), Pr, and uranyl ions. It was found that the separation is much improved when a small amount of uranyl ions is added to the sample solution. A 30:1 mixture of 2.5% n-butyric acid and isopropanol was found to be the best developer. Better results were obtained with samples containing three kinds of ions, two kinds of rare earth ions and the uranyl ion. (P.C.H.)

35471 REPORT ON FAST DETERMINATION OF THE IMPORTANT RADIONUCLIDES (^{89}Sr, ^{90}Sr, ^{131}I, AND ^{137}Cs) IN FOOD AND WATER. K. G. Bergner and P. Jaegerhuber (Chemische Landesuntersuchungsanstalt, Stuttgart). Deut. Lebensm.-Rundschau, No. 12, 359-65(Dec. 1963); No. 1, 11-14(Jan. 1964). (In German)

In the monitoring of food and water for radioactivity, rapidity and accuracy are two requirements. The methods used in the German Republic for the determination of ^{89}Sr, ^{90}Sr, ^{131}I, and ^{137}Cs are reported. The technique used for the evaluation of the sample size is described. (J.S.R.)

35472 ION EXCHANGE METHODS FOR THE ESTIMATION OF Sr^{90} IN RAIN, MILK AND BONE. L. P. Gregory (National Radiation Lab., Christchurch, N. Z.). Health Phys., 10: 483-93(July 1964).

Methods used at the New Zealand Department of Health's National Radiation Laboratory at Christchurch for the estimation of ^{90}Sr from fallout in rainwater, milk ash, and bone ash samples are presented. These methods have been evolved by adapting and simplifying published procedures in such a way that analyses on large numbers of samples can routinely be carried out by technicians. Sample solutions containing stable strontium carrier are absorbed on Dowex 50-X8 cationic exchange resin. Strontium carrier is separated from other alkaline earth metals by elution with a stabilized ammonium lactate solution. The strontium is recovered as the carbonate prior to ingrowth of daughter ^{90}Y. Yttrium carrier is added, separated as the hydroxide, converted to the oxalate, and counted in a low background beta counter. With biological samples containing a large amount of calcium, a double ion exchange separation of the strontium carrier is required. The method is readily applicable to the measurement of ^{89}Sr. (auth)

35473 CHROMATOGRAPHY ON ION-EXCHANGE PAPERS. XV. THE ADSORPTION OF METAL IONS ON CATION EXCHANGERS FROM PERCHLORIC ACID SOLUTIONS. M. Lederer and F. Saracino (CNR and Istituto di Chimica Generale ed Inorganica, Rome). J. Chromatog., 15: 80-2(June 1964).

A comparison was made between the adsorption properties of cellulose sulfonic acid exchanger and a resin sulfonic acid exchanger for metal ions in perchloric acid solutions. The metal ions studied included: Ag, Tl, Re, Cd, Co, Ni, Zn, Mn, Cu, Pb, UO_2, Al, Ga, Sc, Y, La, Fe, Bi, Th, and Zr. (P.C.H.)

35474 THE EXTRACTION OF URANIUM(VI) AND PLUTONIUM(IV) FROM NITRIC ACID BY AMINE OXIDES. J. Kennedy and R. Perkins (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Inorg. Nucl. Chem., 26: 1601-3(Sept. 1964).

Investigations were made on the extracting properties of solutions of amine oxides in dibutyl carbitol (DBC). Only marginal differences were found to exist between Alamine 336 and Alamine oxide as extractants for uranium(VI) from nitric acid. Extraction of plutonium(IV) with Alamine oxide was however much lower than with Alamine 336 in the (HNO_3) range 0.5-4.5 M, but at higher acidities the difference was not appreciable. In general, the slopes (1.95 for Pu(IV) and 0.9 for U(VI)) were consistent with the extraction of the species $Pu(NO_3)_6^{3-}$ and $UO_2(NO_3)_3^{1-}$, as in the case of extraction by amines. (P.C.H.)

35475 CONDITIONS FOR THE SEPARATION OF RARE EARTH RADIOISOTOPES FROM SALTS OF ADJACENT RARE EARTHS BY ION-EXCHANGE. G. C. Martin, Jr. (Univ. of Notre Dame, Ind.). J. Inorg. Nucl. Chem., 26: 1621-3(Sept. 1964).

A procedure was developed for obtaining pure rare earth activities for activation analysis and β-γ studies. The complete separation of rare earth activities from milligram amounts of salts of adjacent lower Z rare earths was achieved by ion exchange method at elevated temperatures using hot water circulating through the column jackets, ammonium α-hydroxy isobutyrate as eluant and Dowex 50W-X12 (200-400 mesh) cation exchange resin. Conditions for the separation of two adjacent rare earths, two rare earths two atomic numbers apart, and three adjacent rare earths (Z, Z ± 1) are listed. (P.C.H.)

35476 DETERMINATION OF THE RADON EMANATION FROM CARBONATE ROCKS AND ITS POTENTIAL HAZARD IN BUILDING MATERIALS. A. F. Gabrysh, N. D. McKee, and H. Eyring (Univ. of Utah, Salt Lake City). Mater. Res. Std., 2: 265-8(Apr. 1962).

Structures made of aggregate containing radioactive minerals are of increasing concern to the geneticist, and a laboratory analysis of the emanating power of rocks used for aggregate is essential to safeguard persons from unnecessary radiation hazards. To this end, an efficient technique to dissolve large rock specimens (10 to 80 g) bearing small amounts of Ra and to determine their emanating power was developed. A procedure is given also for determining the small quantities of Rn where α particles from Rn, Ra A, and Ra C are counted. Analysis was first made with rock in solid form; then an assay was made with the material containing Ra in a clear acid solution. The method described for decomposing rocks with HNO_3 and HF was found to be superior to several other methods since it enables efficient decomposition and dissolution of large dolomite rock specimens. The variables associated with a solid specimen are eliminated, and the total amount of emanation formed in the rock can then readily be calculated. Results for several specimens are given, showing the large variations (up to 3×10^{-12} C of Rn per g) in emanating power for specimens taken from within a 200-yd radius of each other, and pointing to the need for controlled monitoring of building materials. The use of building material causing abnormally high background radiation and its genetic significance are discussed, and it was concluded that the added exposure of individuals (such as young people attending the same school for many years) to building materials causing abnormally high background makes such genetic hazards a serious and urgent problem. The results suggest that, if used as building materials in schools and homes, such rocks could increase the long-range radiation doses received by the inhabitants and result in an unfavorable influence on genetic and health conditions. (BBB)

35477 NOTES ON ISOTOPIC EXCHANGE REACTIONS. IV. DISCRETE PROCESS MODEL FOR ION EXCHANGE CHROMATOGRAPHY AND ITS APPLICATION TO ISOTOPE SEPARATION. Kenji Ishida (Japan Atomic Energy Research Inst., Tokyo). Nippon Genshiryoku Gakkaishi, 6: 386-92(July 1964). (In Japanese)

Mathematical models of elution development and frontal analysis were investigated by means of a discrete process for ion exchange chromatography, assuming both local

equilibrium and linear adsorption isotherm in column. It is possible, according to this model, to derive easily the conditions to make the isotopic separation factor large. (auth)

35478 METHOD FOR THE DETERMINATIONS OF NIOBIUM AND TANTALUM IN TITANIUM ALLOYS AND ZIRCONIUM-BASE ALLOYS. Toshio Sawada and Sakae Kato (Sumitomo Light Metal Industries, Ltd., Nagoya, Japan). Nippon Kinzoku Gakkaishi, 28: 180-7(1964). (In Japanese)

A method for the anion exchange separation and gravimetric determination of niobium and tantalum in titanium alloys and zirconium-base alloys was developed. Niobium up to 40 mg and tantalum up to 60 mg in 6N hydrofluoric-4N hydrochloric acid solution containing a maximum of 2.5 g of titanium or zirconium ion per 50 ml, can be quantitatively adsorbed on a 35-cm column prepared from 25 ml (swelling volume in water) of the strong-base anion exchange resin Dowex 1-X4(F,Cl) at the flow rate from 3 to 4 ml per cm^2 per minute. After washing the column, niobium containing no tantalum can be eluted with 200 ml of 3M ammonium chloride-1N hydrofluoric acid solution (A), and tantalum containing no niobium with 200 ml of 3M ammonium chloride-1M ammonium fluoride solution. For a mixture of niobium and tantalum, niobium can be separately eluted with 200 ml of 2.3N hydrofluoric-3.0N hydrochloric acid solution (B). The eluate (A) containing niobium is neutralized with ammonium hydroxide solution. Then niobium, and tantalum in the eluate are precipitated with cupferron at the temperature below 10°C after adjusting the acidity to 1 ~ 2N by the addition of 8 g of boric acid and sufficient hydrochloric acid. Niobium in the eluate (B) is also precipitated quantitatively from 2 ~ 3N hydrochloric solution with cupferron after the addition of 40 ml of ammonium hydroxide solution and 15 g of boric acid. The precipitates are filtered, washed, ignited at 1000°C for an hour, and weighed as Nb_2O_5 and Ta_2O_5, respectively. Nitric acid may be present up to 3N under the conditions of the adsorption. All elements normally found in titanium alloys and zirconium-base alloys cause no interference under the developed conditions. Amounts of 0.1 ~ 30% niobium, and 0.1 ~ 5% tantalum in titanium alloys and zirconium-base alloys are determined by a developed method, the results of which show moderate precision and satisfaction. (auth)

35479 ON THE DETERMINATION OF NIOBIUM IN HEAT-RESISTING STEEL BY THE SPECTROPHOTOMETRIC METHOD. Takashi Sakaki (Japan Special Steel Co., Ltd., Tokyo). Nippon Kinzoku Gakkaishi, 28: 222-7 (1964). (In Japanese)

The spectrophotometric method using xylenol orange was studied for the purpose of establishing a simple and accurate method for determining the amount of niobium in heat resisting steel. First of all, the condition for the formation of the xylenol orange complex salt of niobium was studied. Next, the effect of the coexisting elements was determined experimentally, and the procedure was decided. The xylenol orange complex salt of niobium is formed quantitatively in a short period in a tartaric acid solution of pH 3.00 ~ 3.35 by heating in a boiling water bath. The absorption maximum of this complex salt is at 530 ~ 565 millimicrons. At 565 mμ this wavelength, the relation between the amounts of niobium and the absorbance followed Beer's law in the range from 0.00 to 0.25 mg/100 ml of niobium. In this method, there is no significant effect even in case 0.5 mg each of chromium, cobalt, tantalum, and titanium, 0.1 mg of copper, 3 mg of iron, 1 mg each of manganese and nickel, 10 mg of molybdenum, and 20 mg of tungsten are contained in the separated sample solution. Aluminum, vanadium, and zirconium interfere markedly. Potassium pyrosulfate, which is used for the fusing of niobium pentoxide, is harmful. However, this effect appears constant in the range from 0.4 to 0.6 g in the separated sample solution. As a result of the experiment, a method was established in which 0.1 to 5% of niobium in heat resisting steel can be measured easily and accurately. The amount of niobium in actual samples was measured by this method with satisfactory results. (auth)

35480 THE ISOLATION OF PROMETHIUM-147 AND EUROPIUM-155 FROM A FISSION PRODUCT MIXTURE BY EXTRACTION WITH TRIBUTYLPHOSPHATE (TBP). N. E. Brezhneva, V. I. Levin, G. V. Korpusov, E. N. Patrusheva, N. M. Man'ko, and L. T. Khoreshko. Radiokhimiya, 6: 265-75(1964). (In Russian)

^{147}Pm and ^{155}Eu were separated from rare earth concentrate by solvent extraction with TBP saturated with HNO_3. The tracers ^{140}La, ^{144}Ce, ^{143}Pr, ^{147}Nd, ^{147}Pm, ^{153}Sm, $^{152-154}Eu$, ^{90}Y, and ^{91}Y were used to follow the behavior of the various fission rare earths. Preliminary experiments with the corrosion products Fe and Cr showed that Cr is not extracted by TBP at high HNO_3 concentrations, but that the distribution coefficient of Fe is sufficiently high to interfere with the extraction of rare earths at high HNO_3 concentrations. The extraction of rare earths by TBP is most effective at 12 to 16N HNO_3. The rare earths occur as the $H_3M(NO_3)_6 \cdot 3TBP$ complex at these high HNO_3 concentrations. The extraction of rare earths by TBP from HNO_3 solutions decreases significantly with increasing temperature. Thus, the rare earths can be readily back-extracted from the organic TBP phase by heating the weak nitric acid aqueous phase. A 20-stage and a 50-stage mixer-settler were used to separate 4.4 Curies of ^{147}Pm, and 60 mC of ^{155}Eu from a simulated fission product rare earth concentrate containing 4.8 curies of initial ^{147}Pm. Thus, the ^{147}Pm yield was 90%, and its purity was 99.85%. Radiochemical analyses of samples taken from the various stages showed that the experimental results were in agreement with the theoretical values for the separation, since the efficiency of each stage was almost 100%. The ^{155}Eu fraction was contaminated with 20% ^{147}Pm after a 20-stage extraction. Thus, a 50-stage extraction is required to obtain ^{155}Eu of high purity. (TTT)

35481 DISTRIBUTION COEFFICIENTS OF EUROPIUM BETWEEN NITRIC ACID SOLUTIONS AND A NUMBER OF PHOSPHO-ORGANIC COMPOUNDS. E. N. Patrusheva, N. E. Brezhneva, and G. V. Korpusov. Radiokhimiya, 6: 276-80(1964). (In Russian)

Tracer $^{152-154}Eu$ was used to compare the extraction of europium from 0.1 to 15N HNO_3 with a 0.92M solution of tributylphosphate (TBP) $(C_4H_9O)_3PO$, dibutylphosphonate (DBP) $(C_4H_9O)_2PO(C_4H_9)$, dibutylphosphinate (DBPI) $(C_4H_9O)PO(C_4H_9)_2$, and tributylphosphine oxide (TBPO) $(C_4H_9)_3PO$ in toluene. Each compound differs from its predecessor by replacement of an ether group by a group where carbon is directly bonded to the phosphorus atom. The distribution coefficient shows a maximum at 0.1 to 4.0N HNO_3, a falling-off to a minimum at ~8.0N, and a sharp increase in the distribution coefficient above 8N HNO_3. TBPO shows a higher distribution coefficient than the phosphinate (DBPI), which in turn shows a higher distribution coefficient than the phosphonate DBP. Tributylphosphate (TBP) shows the lowest distribution coefficient in the series of compounds. The distribution coefficient of europium increases sharply with increasing nitrate con-

centration, especially with the phosphine oxide TBPO as the extracting solvent. The difference in the europium distribution coefficients with the various solvent extractants decreases with increasing nitric acid concentration. (TTT)

35482 THE EFFECT OF THE MAGNITUDE OF ION CHARGE ON THE SOLVENT EXTRACTION OF A COMPONENT. THE EXTRACTABILITY OF SALTS HAVING A COMPOSITION OF 1:1, 1:2 AND 1:3. V. I. Kuznetsov and L. I. Moseev. Radiokhimiya, 6: 280-6(1964). (In Russian)

In systems where the extracting salt may be of variable composition, it was found that a salt having the simplest 1:1 composition is extracted the most readily. Thus, a singly-charged anion is the most suitable partner for a singly-charged cation. A doubly-charged anion is most suitable for a doubly-charged cation, and a triply-charged anion is best for complexing a triply-charged cation. These conclusions were arrived at from a study of five systems: diphenylguanidine-iron (III)-thiocyanate; the cation $[Cd(o\text{-phenanthroline})_3]^{2+}$-iron(III)-thiocyanate; diphenylguanidine-$[Cd(o\text{-phenanthroline})_3]^{2+}$-iron(III)-thiocyanate; $[Co(o\text{-}C_6H_8N_2)_3]^{3+}$-iron(III)-thiocyanate; and systems containing anions of the Orange 2B dye. In each case the salts having a simple 1:1 composition were extracted most readily. These rules can be used to predict an increase or decrease in solvent extraction with a change in conditions, and to study the state of an ion in solution. (TTT)

35483 THE EXTRACTION OF SCANDIUM BY THE ALKYL PHOSPHORIC ACIDS. A. P. Samodelov. Radiokhimiya, 6: 286-91(1964). (In Russian)

Tracer ^{46}Sc was used to follow the distribution coefficient of scandium (initially 0.025 M) from a 0.1 to 10 N HCl or HNO_3 into 0.01 M monobutylphosphate or dibutylphosphate. Extraction with the isobutyl derivatives was also investigated, and it was found that the normal butyl compound was more effective than the isobutyl compound. Scandium forms stable dialkylphosphates in concentrated HCl or HNO_3, but the monoalkylphosphates of scandium are not stable in strong acid, and hence, are not as valuable as the dialkylphosphates of scandium for solvent extraction work. Scandium is extracted by dibutylphosphate significantly better from HNO_3 solutions than from HCl solutions. At low concentrations of the dialkylphosphate (HA), the reaction with scandium can be represented as follows: $Sc^{3+} + 1.5\ H_2A_2 \rightleftharpoons ScA_3 + 3H^+$, since the dialkylphosphate is dimeric in non-polar solvents. With increasing concentration of dialkylphosphate extractant, the distribution of scandium becomes proportional to the cube of the dialkylphosphate concentration, and it can be assumed that the scandium alkylphosphate dissolves in an excess of the reagent as follows: $ScA_3 + 1.5\ H_2A_2 \rightleftharpoons Sc(HA_2)_3$. A solid compound was isolated, and an infrared spectrum analysis showed that nitrate or chloride is not present in the compound. The logarithm of the reaction constant of scandium with dibutylphosphate in HNO_3 solutions was determined to be $\lg K = 34 \pm 0.5$, as calculated from the distribution data, and the dimerization and dissociation constants of dibutylphosphoric acid. (TTT)

35484 AN ELECTROLYTIC METHOD OF DECOMPOSING A CERIUM AMALGAM. M. G. Sayun and K. Kh. Tsareva. Radiokhimiya, 6: 360-6(1964). (In Russian)

An electrolytic method of decomposing a cerium amalgam is a necessity in using electrolysis for the separation of rare earth elements. Tracer ^{141}Ce was used in developing a method for the electrolytic extraction of cerium from an amalgam. A determination of the anodic potential as a function of cerium concentration in the amalgam shows that the anodic potential is shifted to higher electronegative values on increasing the cerium concentration from 0.01 to 1.0 g-atom per 1 liter of mercury. The maximum change in anodic potential is 0.93 volts (at 80°C and 100 mamps/cm^2), while the minimum change is 0.06 volts at low temperatures and low current densities. At low current densities (1 mamp/cm^2), the anodic potential is −0.35 volts at 20°C, and −0.73 volts at 80°C. On increasing the current density to 100 mamps/cm^2, the anodic potential is shifted to the positive side. A higher temperature shifts the potential to the side of higher electronegative values. Thus, at a current density of 100 mamps/cm^2, a temperature increase of 60° led to a shift in potential of 0.66 volts, or a change of 0.011 volts per 1° temperature rise. A cerium amalgam can be quantitatively decomposed in HCl or H_2SO_4 at a current density of 10 mamps/cm^2 or less. The current yield is 102 to 771%. The cathodic deposition of cerium, and the anodic dissolution of the cerium amalgam are irreversible processes. The anodic potential of a cerium amalgam is less than −0.77 volts, which is almost 1 volt more positive than the cerium reduction potential on a mercury cathode. (TTT)

35485 THE DETERMINATION OF PROTACTINIUM IN LOW-ACTIVITY, SILICATE MATERIALS. A. N. Elizarova and Yu. V. Kuznetsov. Radiokhimiya, 6: 375-6(1964). (In Russian)

It is a difficult problem to determine the absolute yield of ^{231}Pa in sedimentary deposits because of its low abundance. Since the ^{231}Pa is determined by α counting, and the recovery correction is performed by adding the β emitter ^{233}Pa, it is necessary to recover the ^{231}Pa carrier-free with complete radiochemical decontamination. A method involving precipitation followed by solvent extraction was developed for this purpose. A sample of 20 to 30 grams is heated in a muffle furnace to remove organic matter. Tracer ^{233}Pa is added, and the sample is treated with NH_4F to volatilize silica. The residue is treated with dry oxalic acid to eliminate most of the fluoride ion. The Pa is carried by precipitating calcium oxalate from 0.3 to 0.5N HCl solution. The calcium oxalate precipitate is fused with $K_2S_2O_7$ to remove the last traces of fluoride ion that forms a soluble complex with Pa. The Pa is leached from the pyrosulfate melt with hot distilled water, and coprecipitated on $Fe(OH)_3$. The Pa is then carried on MnO_2 a number of times from a 1.5 to 3.0N HNO_3 solution in order to eliminate Fe, Al, U, Th, and other elements. The MnO_2 precipitate containing the Pa is dissolved in 8N HCl, and the Pa is extracted into an equal volume of diisobutylketone, which is scrubbed with 8N HCl. This step separates U and Th from the Pa. The Pa is back-extracted into 8N HCl + 0.5N HF. The Pa is completely decontaminated from U, Th, and Pa by this procedure. The average yield of Pa is 60%, and the accuracy is ±10%. This method was used to determine the Pa content in ocean sediments containing 10^{-11} to 10^{-12} g of Pa/g of sediment. (TTT)

35486 DETERMINATION OF RADIUM IN WATER. Radiochemical Analysis of Water. F. B. Barker and J. O. Johnson (Geological Survey, Washington, D. C.). Geological Survey Water-Supply Paper 1696-B. 1964. 29p. (GPO)

The approximate concentration of ^{226}Ra is determined after coprecipitating radium with barium sulfate. The short-lived daughters of radium are allowed to grow for 10 to 12 days, then the alpha activity of the precipitate is

measured and compared with that of a precipitate containing a known amount of ^{226}Ra. Concentrations of the individual alpha-emitting isotopes ^{223}Ra, ^{224}Ra, and ^{226}Ra, are determined by coprecipitating radium first with lead sulfate, then with barium chloride, and finally with barium sulfate. This final precipitate is initially free of other alpha-emitting nuclides, thus permitting the isotopic composition to be determined by measuring the growth and decay of the alpha activity of the precipitate. (auth)

35487 A FAST AND ACCURATE SURVEY TECHNIQUE FOR BOTH RADON-222 AND RADIUM-226. Henry F. Lucas, Jr. (Argonne National Lab., Ill.). p.315-29 of "The Natural Radiation Environment." Chicago, University of Chicago Press, 1964.

A study of ^{222}Rn and ^{226}Ra in water was begun to study the effects of internally deposited radioelements on man. A description is given of a mail-order system of sample collection. Methods for ^{222}Rn and ^{226}Ra assay are described. (D.L.C.)

35488 USE OF ACTIVATION ANALYSIS FOR COPPER-ORE SORTING. H. Ramdohr (Institut Karlsruhe der Isotopen-Studiengesellschaft e. V., Ger.). p.331-6 of "Atomstrahlung in Medizin und Technik." Munich, Verlag Karl Thiemig KG, 1964. (In German)

The applicability of activation analysis to the grading of Cu ores was tested on an ore of known composition. The 0.511-Mev line of ^{64}Cu was used in the γ spectroscopy. The coincidence arrangement designed for the measurement of the radiation and the construction of the research installation are described. No results are reported. (J.S.R.)

35489 A DOUBLE-FILTER DEVICE TO MEASURE RADON AND THORON IN BREATH. W. Jacobi (Hahn-Meitner-Institut für Kernforschung, Berlin). Vienna, International Atomic Energy Agency, 1964, Preprint SM-52/53, 23p. (CONF-448-18)

From IAEA Symposium of the Assessment of Radioactive Body Burdens in Man, Heidelberg, May 1964.

The measurement of radon and thoron in breath is a well-known sensitive method to estimate the radium- and thorium-body burden in man. However, at low concentrations the conventional Rn- and Th-counting methods are rather difficult in application. A new method is distinguished by its simplicity and sensitivity as well as the advantage to determine low Th-concentrations in presence of Rn. The exhaled air streams through a fibrous filter of high efficiency for Rn- and Th-decay products into a chamber, where new decay product-atoms are formed by the decay of Rn- and Th-atoms. These fresh buildup decay products are filtered out from the streaming air by a second filter at the air outlet of the chamber. The activity of the outlet filter is directly proportional to the Rn- and Th-concentration in the exhaled air and can be easily measured by conventional filter counting techniques. Devices using this principle are described, which allow the simultaneous measurement of Rn- or Th-concentrations of 100 pc/m^3 in breath with an error below 10%. The Th-sensitivity is independent of the Rn-concentration in the air. (auth)

35490 AN APPARATUS FOR THE VAPORIZATION-CONCENTRATION METHOD OF SPECTROCHEMICAL ANALYSIS. Robert F. O'Connell (Sperry Rand Corp., Sudbury, Mass.). 11p. (CONF-138-2)

From 11th Detroit ANACHEM Conference, Detroit, Oct. 1963.

An apparatus for using the vaporization-concentration method of separation of impurities for spectrochemical analysis of refractory materials is described. The unit is portable and can be used with controlled atmospheres at either positive or negative pressures. A temperature of over 2300°C can be attained in less than one minute. Temperature is read with a disappearing filament optical pyrometer and is controlled by variations of the input voltages by means of two autotransformers. Several other possible applications of the unit are also suggested. (auth)

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Refer also to abstract 36837.

35491 (ASD-TDR-63-476(Pt.II)) EFFECT OF IMPURITIES OF CESIUM FUEL UPON ION ENGINES. B. A. Free (General Electric Co. Missile and Space Div., Cincinnati). June 1964. Contract AF33(657)-9163. 123p.

The effects of selected contaminants on the ionization behavior of cesium flowing through a porous tungsten surface were studied. The measurement criterion is critical temperature, where the degree of ionization abruptly rises from a negligible level to a value approaching 100%. The impurities studied are sodium, potassium, and oxygen, all at the 0.3% levels. The effect of sodium and potassium is to raise the critical temperature, whereas oxygen has no effect. Flow rate studies over a limited range have shown that critical temperature is adversely affected by increased flow. An attempt to cancel the adverse effect of the alkali metal impurities by controlled oxygen addition indicated some success, but the effect observed may be within the limits of experimental error. Areas for future investigation are suggested. (auth)

35492 (BM-RI-6500) ELECTRICAL CONDUCTIVITY AND DENSITY OF MOLTEN SYSTEMS OF URANIUM TETRAFLUORIDE AND THORIUM FLUORIDE WITH ALKALI FLUORIDES. E. A. Brown and Bernard Porter (Bureau of Mines. Reno Metallurgy Research Center, Nev.). Oct. 1963. 20p.

Electrical conductivities and densities of the $LiF-UF_4$, $LiF-ThF_4$, $NaF-UF_4$, and $NaF-ThF_4$ systems were measured as functions of composition and temperature. The specific conductance and density varied linearly with temperature. Molar and equivalent volumes, as well as heats of activation for conductance, were calculated from the experimental data. At 1,000°C, the molar volumes ranged from 16 to 40 cubic centimeters per mole and the specific conductance ranged from 9.8 to 2.5 per ohm-centimeter as the actinide metal fluoride concentration changed from 0 to 60 mole-percent. Heats of activation for conductance were 3 to 7 kcal per mole. The data are interpreted on the basis of a semi-lattice model for the melts. (auth)

35493 (BNL-7278) MAGNETIC STRUCTURE OF BINARY FLUORIDES CONTAINING Mn^{2+}. S. J. Pickart, H. A. Alperin (Naval Ordnance Lab., White Oak, Silver Spring, Md. and Brookhaven National Lab., Upton, N. Y.); and R. Nathans (Brookhaven National Lab., Upton, N. Y.). [1963]. Contract [AT(30-2)-Gen-16]. 6p.

Spin orderings of the binary fluorides with chemical formula $XMnF_3$ (X = Na, Rb, Cs, and NH_4) were investigated by neutron diffraction. The antiferromagnetic lattices of the compounds with X = Na, Rb, and NH_4 are found to be of the same basic type as found in $KMnF_3$ (G-type). In $CsMnF_3$, which is hexagonal, the Mn^{2+} layers are arranged in an antiparallel sequence along the c-axis, with the spin direction normal to the axis. (auth)

35494 (BNL-7289) THE KINETICS OF SOME OXIDATION-REDUCTION REACTIONS INVOLVING MANGANESE (III). H. Diebler and N. Sutin (Brookhaven National Lab., Upton, N. Y.). [1963]. Contract [AT(30-2)-Gen-16]. 22p.

The kinetics of several oxidation-reduction reactions involving manganese(III) have been studied spectrophotometrically by the use of a flow technique. The free energies of activation for the oxidation of various substituted tris-(1,10-phenanthroline) complexes of iron(II) by manganese (III) in perchloric acid and in pyrophosphoric-sulfuric acid media were found to be linearly related to the standard free energy changes of the reactions. The application of the Marcus theory to the reactions of manganese(III) with iron (II) and with various substituted iron(II)-phenanthroline complexes and to the reaction of cobalt(III) with manganese (II) in perchloric acid leads to an estimate of about 10^{-4} F^{-1} sec^{-1} for the rate constant of the manganese(II)-manganese(III) electron exchange reaction at 25.0°. Attempts to determine the rate constant for this exchange by a radioactive tracer method were unsuccessful. (auth)

35495 (BNL-7290) NEUTRON DIFFRACTION STUDIES AT THE PUERTO RICO NUCLEAR CENTER. I. Almodovar, H. J. Bielen, B. C. Frazer, and M. I. Kay (Puerto Rico Nuclear Center, Mayagüez). [1963]. Contract [AT(30-2)-Gen-16]. 14p.

Preliminary results are given from single-crystal structure analysis of $CaWO_4$ (scheelite), magnetic structure of $CuSO_4$, crystal structure of $BaNiO_2$, and magnetic properties of Fe_2SiO_2. (R.E.U.)

35496 (BNL-7307) PREPARATION AND SOME PROPERTIES OF KRYPTON DIFLUORIDE. D. R. MacKenzie (Brookhaven National Lab., Upton, N. Y.). [Aug. 22, 1963]. Contract [AT(30-2)-Gen-16]. 3p.

KrF_2 was prepared by using an electron beam to irradiate Kr and F_2 at −150°C. It is a finely divided white solid and sublimes without decomposition. Its volatility is similar to that of KrF_4, and it is probably less stable than KrF_4. (D.L.C.)

35497 (GNEC-354) INVESTIGATION OF CATALYTIC RECOMBINATION OF RADIOLYTIC OXYGEN AND HYDROGEN. Quarterly Progress Report No. 3, April–June 1964. Gilbert M. Brown and C. Thomas Sawyer (General Nuclear Engineering Corp., Dunedin, Fla.). July 10, 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(40-1)-3151. 52p. (EURAEC-1133)

Performance testing of catalysts continued. Tests on Catalysts "G" through "I" and special tests on Catalysts "C" and "D" were completed. Except for Catalyst "H," these tests produced data similar to those for Catalysts "A" through "F." Tests on each of the other two provided data which indicated that either could be used to reduce oxygen and hydrogen concentrations in steam from the parts per million range to the parts per billion range. No evidence of unallowable physical deterioration nor poisoning was noted. Sufficient data were obtained for each catalyst to enable the writing of equations which expressed the reduction in gas concentrations as functions of bed depth, temperature, steam flow rate, and pressure. Additional tests were conducted on Catalysts "C" and "D" whereby either saturated or slightly superheated steam containing hydrogen and oxygen were passed through the respective beds at low velocities, temperatures, and pressures. Such tests were representative of recombiners which depend upon natural circulation flow of gases. These tests supported the belief that saturated steam, if not wet, could be passed through the respective beds without deleterious effects. A bed of pure nickel ribbon was tested for catalytic properties also. No discernible reaction between the H_2 and O_2 was produced. Design changes were completed for the steam test loop to enable upstream and downstream exposure of corrosion specimens while a recombiner is being operated over extended periods. Stressed, type 304 stainless steel corrosion specimens were exposed to 530°F steam which contained 1.8-2.2 ppm of chlorides, 0.17-0.25 ppm O_2, and 1% moisture. Other specimens were exposed to the same steam but after an oxygen addition which resulted in a concentration of 30-35 ppm. After nine days of exposure, each of the latter specimens exhibited 30-40 cracks while only two cracks were found in the entire set of the former. The cracks were generally transgranular. It is possible that a second condition difference existed because of different locations within the loop. (auth)

35498 (HW-75976) THE EFFECT OF CHEMICAL ADDITIVES AND COATING MATERIALS ON THE ADSORPTION OF RADIONUCLIDE PARENT ELEMENTS ON ALUMINUM SURFACES. R. W. Perkins and D. E. Robertson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Dec. 26, 1962. Contract AT(45-1)-1350. 17p.

Laboratory studies have been conducted under simulated reactor operating conditions to determine the effect of various chemical additives and coatings on the adsorption of trace elements on aluminum surfaces. Of the materials tested, silicate additives and organic ink coatings were by far the most effective, reducing the adsorption of arsenic and phosphorus tracers by as much as one to three orders of magnitude. The laboratory techniques and results are discussed. (auth)

35499 (IS-812) A STUDY OF THE YTTRIUM–OXYGEN SYSTEM. Robert Clark Tucker, Jr., and O. N. Carlson (Ames Lab., Ames, Iowa). Feb. 1964. Contract W-7405-eng-82. 52p.

An equilibrium phase diagram has been proposed for the yttrium–oxygen system. Evidence of a eutectoid transformation at 1180°C was obtained from the examination of microstructures and supported by differential thermal analysis, resistivity, and x-ray-diffraction data. The solid solubility of oxygen in α yttrium was found to increase from less than 1000 ppm at 600°C to 3.3 wt % at the eutectoid temperature. The intersection of the β solvus with the eutectoid horizontal established the eutectoid composition as 3.8 wt % oxygen. The β solvus increased from this to 7.3 wt % oxygen at 1560°C. The $\alpha/\alpha+\beta$ boundary was tentatively determined from resistivity data. The solidus was found to exhibit a maximum at about 5.5 wt % oxygen and 1670°C and a eutectic horizontal at 1560°C. The eutectic composition was estimated at 9.7 wt % oxygen from the intersection of the liquidus and the eutectic horizontal. This estimate was supported by microstructural evidence. (auth)

35500 (LA-2997) AN ALTERNATIVE TREATMENT OF SOLVENT ACTIVITY IN THE RAOULT'S LAW REGION— THE GALLIUM–CADMIUM SYSTEM. Guy R. B. Elliott, Joe Fred Lemons, and Harold S. Swofford, Jr. (Los Alamos Scientific Lab., N. Mex.). Sept. 1, 1963. Contract W-7405-eng-36. 44p.

The applicability of the equation $a_1 = 1 - k'N_2$ (where a_1 is the activity of the solvent, N_2 is the mole fraction of the solute, and k' is a constant) to dilute solutions is discussed and contrasted with Raoult's Law. The activity of Cd in dilute solutions of Ga in Cd was determined experimentally and the data fitted to the equation. Data from the literature

are discussed in terms of their fit to the above equation or Raoult's Law, and the application of the Gibbs-Duhem treatment in concentrated solutions is commented on. (auth)

35501 (NAA-SR-9672) BERYLLIUM OXIDATION RESEARCH RELATIVE TO THE SNAP-8 REACTOR. G. Ervin, Jr., and T. L. Mackay (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). July 24, 1964. Contract AT(11-1)-Gen-8. 46p.

Corrosion of beryllium by high-temperature air is a potential problem in SNAP 8 ground test reactors. Results are presented of a research study in which it was shown that oxidation of beryllium, in the temperature range of 500 to 900°C, proceeds very slowly during an initial protective period, but catastrophically during a subsequent accelerating period. Analysis of oxidation kinetics during the protective period showed a parabolic rate, and a decrease in rate with pressure, proportional to the $\frac{1}{5}$th power of the oxygen pressure, in agreement with the theory that oxidation rate is controlled by diffusion of beryllium ion vacancies in the BeO film lattice. The period of stability before catastrophic failure was shortened significantly by the presence of moisture; on the other hand, the presence of 1% calcium in the beryllium provided a high degree of stability. The cause of catastrophic failure is attributed to pits that grow in the metal under the protective film of adherent oxide. The pits are a few microns wide and deep, and number about 10^6 per cm^2, but grow as oxidation proceeds until they weaken and undermine the metal surface, eventually causing small fragments of metal to break away with resultant accelerating oxidation. Evidence was accumulated in support of the hypothesis that the pits occur at dislocations in the metal, where the metal is strained and more reactive. Predictions of stability of beryllium for 10,000 hours under test reactor conditions must depend on long extrapolations. Based on such extrapolations, it may be concluded that in reactors in which the ground test environment is a relatively good vacuum, such as 10^{-6} torr, unprotected beryllium may be expected to show accelerated oxidation after 4,000 hours at 1100°F is some of the atmosphere is moisture, with a probable lifetime before catastrophic failure of about 8,000 hours. In very dry vacuum of 10^{-6} torr, expected lifetime at 1100°F is far in excess of 10,000 hours. (auth)

35502 (NYO-2911-1) THE DEVELOPMENT OF AN EFFECTIVE ALUMINO-SILICATE ADSORBENT FOR RADIOACTIVE WASTE DISPOSAL. Final Report, November 1, 1961–October 31, 1963. W. L. Haden, Jr. (Minerals and Chemicals Phillipp Corp., Menlo Park, N. J.). July 1964. Contract AT(30-1)-2911. 48p.

A natural mineral exchange material may vary in composition and always contains certain amounts of extraneous minerals, which can affect the exchange characteristics of the overall mineral. When used in radioactive waste treatment, these "impurities" are an unknown variable. The development of a mineral synthesized from its basic components, as attempted in this study, would serve (1) to determine the role of extraneous minerals and the mineral's structure on stability and kinetics, (2) to determine the role of the exchangeable cation, (3) to determine the role of the process parameters used to synthesize the mineral, and (4) to provide some insight into the geologic history of the natural minerals. Synthetic zeolite materials were prepared from the $Na_2O-Al_2O_3-SiO_2$ system as both amorphous and crystalline products. No novel or especially useful products resulted. As clinoptilolite appeared to have many desirable properties, it was decided that clinoptilolite and related minerals should be the objective of the synthesis work. In the $Li_2O-Al_2O_3-SiO_2$ system, emphasis was placed on the high-silica region. Hydrothermal syntheses of two new mineral phases, designated MCP-II and MCP-III, were accomplished. The former is an acid-resistant zeolite having a characteristic x-ray pattern, while the latter is a layer-type mineral of the montmorillonite type, possibly of the composition $Li_2O \cdot (2Li_2O \cdot Al_2O_3) \cdot 8SiO_2 \cdot xH_2O$, where the lithium appears both as the exchangeable ion and also in the octahedral layer. Another zeolite designated MCP-I may be novel, although there are similarities to a zeolite referred to by Barrer as Species H. Also in this composition range, the synthetic clinoptilolite-like phase obtained by Ames was confirmed. In addition to the usually considered variables of oxide ratios and temperature, the structure of the raw materials is indicated as a very important variable in zeolite synthesis. In addition to the synthesis work, a procedure was developed for pelletizing natural clinoptilolite in the form of acid-resistant pellets and beads. No particular advantage over natural granulated clinoptilolite was found, however. (auth)

35503 (ORNL-3594) MOLTEN-SALT SOLVENTS FOR FLUORIDE VOLATILITY PROCESSING OF ALUMINUM-MATRIX NUCLEAR FUEL ELEMENTS. R. E. Thoma, B. J. Sturm, and E. H. Guinn (Oak Ridge National Lab., Tenn.). Aug. 1964. Contract W-7405-eng-26. 38p.

The results of a search for molten-salt solvents for use in fluoride volatility processing of aluminum-matrix fuel elements are presented. The solubility of aluminum fluoride in various mixtures of fluorides was determined in order to estimate the feasibility and cost of processing methods. Sufficient data were accumulated to construct equilibrium phase diagrams of the solution systems, $LiF-NaF-AlF_3$, $LiF-KF-AlF_3$, $LiF-K_3AlF_6-MF_2$ (where MF_2 is CaF_2, SrF_2, or ZnF_2), and $KF-ZrF_4-AlF_3$. New and revised phase diagrams were determined for the limiting binary systems of the alkali fluorides with AlF_3 by use of a new visual method for determining the occurrence of liquidus transitions. This method provided several advantages not available in classical methods of obtaining liquidus data. For example, it was observed for the first time that immiscible liquids are formed at high temperatures in AlF_3-based systems. The temperatures at which such liquids form are, however, higher than is feasible for adoption in most current chemical technologies. Of the various materials evaluated as solvents for the volatility process, the greatest potential for application was displayed by the $KF-ZrF_4-AlF_2$ system. High solubility and good dissolution rates are afforded by the inexpensive solvent salt K_2ZrF_6. At operating temperatures, approximately 600°C, the AlF_3 capacity of the solvent is in excess of 25 mole %. (auth)

35504 (ORNL-RMIC-2(p.17-61)) LISTS OF AVAILABLE AND DESIRED MATERIALS. T. F. Connolly (Oak Ridge National Lab., Tenn.).

The list of available high-purity elements and compounds give the extent of purity, forms, and the largest size available. Some of them were produced in research, while the others are commercial. The desired materials and their applications or requirements are also listed. (D.L.C.)

35505 (SC-RR-64-552) THE OXIDATION OF U(IV) BY Tl(III) IN THE PRESENCE OF CHLORIDE IN AN AQUEOUS SOLUTION. James O. Wear (Sandia Corp., Albuquerque, N. Mex.). June 1964. Contract AT(29-1)-789. 17p.

The kinetics of the oxidation of U(IV) by Tl(III) were examined in aqueous-chloride-perchlorate solution with the

chloride concentration varied from 10^{-4} to 1 M. The reaction was suppressed by chloride over most of the range, but at high chloride concentration the reaction was independent of chloride. The data are explained by mechanisms involving chloro and hydroxy complexes of both U(IV) and Tl(III). The temperature was varied from 15 to 50°C and the activation energy was found for each rate constant. (auth)

35506 (UCRL-7384) KINETICS OF THE THERMAL DECOMPOSITION OF BERYLLIUM HYDROXIDE. J. Birch Holt (California. Univ., Livermore. Lawrence Radiation Lab.). Sept. 6, 1963. Contract W-7405-eng-48. 20p.

β $Be(OH)_2$ was dehydrated in a vacuum of 10^{-6} mm Hg, and in the temperature range from 135 to 220°C. The weight loss versus time measurements were recorded by an Ainsworth automatic semimicro balance. The initial portion of the decomposition curve was characterized by a decelerating reaction which suggests a diffusional process with an activation energy of 14 kcal/mole. Propagation of the interface into the spherical particles was the rate controlling step of the main reaction with an activation energy of 27.5 kcal/mole. This value was verified by correlation with absolute reaction rate theory. X-ray, infrared, and electron microscope analysis and surface area measurements were also used to further elucidate the mechanism of decomposition. (auth)

35507 (UCRL-13070) DEVELOPMENT OF AN ELECTROLESS GOLD PLATING BATH. Completion Report. B. Luce (Clevite Corp. Mechanical Research Div., Cleveland). Apr. 1, 1963. For Univ. of California, Lawrence Radiation Lab., Livermore. Contract [W-7405-eng-48]. 39p.

Numerous combinations of gold salts, complexing agents, and reductants were evaluated for use as an electroless gold plating bath. The gold–cyanide systems as well as gold-organic sulfur systems appeared to be too stable for autocatalytic reduction at a practical rate of deposition. On the other hand, nitrogen and oxygen containing ligands did not provide enough stability to prevent precipitation of metal in the bulk of the solution. The only combination found to date that will deposit gold at a rate of 0.0001 in. to 0.0002 in. per hour is a metastable solution of gold chloride as source of gold ions, sodium sulfite, or metabisulfite as complexing agent, cyclohexylamine as stabilizing agent, and hydrazine as reductant. (auth)

35508 (UJV-1066/64) THE AQUEOUS CHEMISTRY OF ZIRCONIUM AND HAFNIUM. J. Hála (Československá Akademie Věd. Ústav Jaderného Výzkumu, Řež). [1964]. 35p.

With the exception of hydrolytic and polymerization equilibrium of zirconium and hafnium in solutions, a comprehensive review of the aqueous chemistry of these elements is presented. It covers references up to the beginning of 1964. Complexes with inorganic ligands discussed in detail are those of perchlorate, fluoride, sulfate, chloride, nitrate, and thiocyanate. It is shown that only fluoro- and sulfatocomplexes in acidic solutions can be considered as sufficiently examined. Most important organic ligands in aqueous chemistry of zirconium and hafnium are oxalate, 1,3-diketones, mandelate, hydroxyanthraquinones, azo dyes, and aminopolycarboxylic acids. Therefore, the greatest attention is paid to the discussion of their complexes. A comparison of their properties with those of some other ligands (polyphenols, phenolcarboxylic acids, hydroxyflavonols) has enabled several conclusions on the relative stability of five- and six-membered chelate rings in zirconium and hafnium complexes in solutions. 220 references are included. (auth)

35509 (UJV-1079/64) ON THE MECHANISM OF THE ZIRCONIUM SORPTION ON SILICA GEL FROM NITRIC ACID MEDIUM. R. Caletka, M. Kyrš, and J. Rais (Československá Akademie Věd. Ústav Jaderného Výzkumu, Řež). [1962]. 36p.

The kinetics of sorption of small amounts (10^{-6}M) of Zr on silica gel from HNO_3 solutions were studied using ^{95}Zr tracer. Equilibrium could not be reached in a reasonable time, and the sorption was irreversible. The kinetics of Zr desorption from silica gel were also investigated, and the acidity of the solution from which Zr was originally sorbed was found to exert a memory effect. It is proposed that for acidity <2M, hydrolyzed Zr particles are captured by silica gel; for acidity = 2M, Zr^{4+} ion exchange occurs; and in 6N HNO_3, molecular sorption reaches a maximum. Porosity had a greater effect on the sorption than grain size. (D.L.C.)

35510 (Y-1467) AN APPARATUS FOR CONVERTING URANIUM OXIDES OR HALIDES TO URANIUM HEXAFLUORIDE FOR ISOTOPIC ANALYSIS. J. D. Caylor and S. H. Greaser (Union Carbide Corp. Nuclear Div. Y-12 Plant, Oak Ridge, Tenn.). June 25, 1964. Contract W-7405-eng-26. 12p.

An apparatus has been designed and constructed which is capable of converting uranium oxide or uranium tetrafluoride to uranium hexafluoride for isotopic analysis. Maximum output is about 90 samples in an eight-hour period. Ten samples can be converted per run. (auth)

35511 (ORNL-tr-280) THE RATIO Ce^{+3}/Ce^{+4} IN THE MELTING OF DIFFERENT GLASSES AND ITS INFLUENCE ON THEIR PROPERTIES. V. Gottardi, G. Paoletti, and M. Tornate. Translated by Roger G. Mansfield (Oak Ridge National Lab., Tenn.), from p.412-23 of "Advances in Glass Technology," presented at the Sixth International Congress on Glass, Washington, D. C., 1962. 19p.

On the basis of analytical determination of cerous and ceric oxides, studies were made in numerous meltings, of the variations in the ratio of these two oxides under rigorously controlled conditions. The effects of time and temperature were investigated first in order to establish the presence of cerium in the higher or lower states of oxidation in a glass chosen as a reference standard. The influence of the amount of cerium present in the glass on the Ce^{3+}/Ce^{4+} ratio, and the effects of molar replacements of network-former and modifier oxides in the basic composition, were studied. Cerium acts in the glass structure either as a network former or as a modifier. Its function can be deduced from the experimental results for the various composition studied. The results for glasses containing Al_2O_3 or B_2O_3 are especially interesting. The results reveal certain anomalies which can be correlated with the peculiar structure of these glasses. Addition of cerium oxide (as network former or modifier) influences the absorption and acid-resistance of glasses. The results were confirmed by measurements of transmission and resistance. (auth)

35512 STUDIES ON THE HYDROLYSIS OF METAL IONS. 52. A RECALCULATION OF EMF DATA ON BERYLLIUM HYDROLYSIS. Sirkka Hietanen and Lars Gunnar Sillen (Royal Inst. of Tech., Stockholm). Acta Chem. Scand., 18: 1015-16(1964).

A recalculation of emf data on Be hydrolysis showed that earlier graphical methods gave practically the same result as the computer refinement by LETAGROP. (P.C.H.)

35513 STUDIES ON THE HYDROLYSIS OF METAL IONS. 53. PRELIMINARY NOTE ON THE HYDROLYSIS OF THORIUM(IV). Sirkka Hietanen and Lars Gunnar Sillen (Royal Inst. of Tech., Stockholm). Acta Chem. Scand., 18: 1018-19(1964).

Preliminary results on the hydrolysis of thorium in 3 M NaCl at 25°C are reported. Preliminary LETAGROP calculations were made on the data, which cover a range of total concentration B of Th from 0.001 to 0.100 M. Equilibrium constants, with the standard deviations σ, found were: $10^{10}\beta_{21} = 8.9 \pm 2.9$; $10^{3}\beta_{12} = 2.24 \pm 0.81$; $10^{5}\beta_{22} = 1.98 \pm 0.07$; $10^{9}\beta_{32} = 1.47 \pm 0.22$; $10^{37}\beta_{14,6} = 2.96 \pm 0.39$; and $10^{41}\beta_{15,6} = 4.28 \pm 0.69$. As far as the calculations have proceeded the data indicate, besides the mononuclear $Th(OH)_2^{2+}$, three binuclear complexes (1,2), (2,2), and (3,2), and two hexanuclear complexes, (14,6) and (15,6). (P.C.H.)

35514 ISOTOPE EFFECTS ON ACIDITY. Martin A. Paul (Harpur Coll., Binghamton, N. Y.). Baskerville Chem. J., City Coll. N. Y., 12: 3-6(1963).

The use of deuterium (D) in isotope acidity research was reviewed. Investigations by conductimetric and potentiometric methods showed that dissociation constants for D-substituted weak acids in solvent D_2O had values smaller by several fold than the values for the corresponding ordinary acids in H_2O. The effect appears to be a general one. On the other hand, many acid-catalyzed reactions were found to take place in D_2O at rates several times faster than in H_2O under comparable conditions. This effect, however, is not completely general since several reactions are known for which the rate is greater in H_2O than in D_2O. The D isotope effect on acid catalysis is related to the effect on acid strength. One possible mechanism for acid catalysis is based on the assumption that equilibrium is rapidly established between the reacting substance S and its conjugate acid SH^+ according to the equation $S + H^+ \rightleftharpoons SH^+$ is discussed. For reactions taking place according to this mechanism, the question of how isotopic substitution affects the rate reduces to the more general question of how it affects acid strength. In terms of classical valency concepts, it is difficult to explain how isotopic substitution can have any effect on acid strength; therefore, an explanation is offered in terms of quantum mechanics. Various factors that affect ionization energy are discussed with reference to data for the dissociation constants of a series of organic acids in H_2O and D_2O. Measurements of the catalytic coefficients for OD^- in D_2O and for OH^- in H_2O are considered for a variety of base-catalyzed reactions. The value for OD^- is greater than for OH^- by a factor within the range 1.2 to 1.4. Among the examples cited are the saponification of ethyl acetate (1.33), hydrolysis of acetonitrile (1.20), ionization of nitroethane (1.39), ionization of 2-nitropropane (1.36), isotope exchange by phenylacetylene-t_1. These results suggest that the base strength for OD^- in D_2O is higher than for OH^- in H_2O by a factor of about 1.3, that is, the acid strength for D_2O is lower than for H_2O by a factor having this same value. The question of whether transfer from H_2O to D_2O as solvent introduces medium effects of a general nature (as with any change of solvent), complicating the interpretation of relative acidity data, is also discussed. (BBB)

35515 A STUDY OF THE SORPTION OF METAL IONS BY COTTON CLOTH. Reiko Koga, Yoshiharu Shinozaki, Gisuke Meshitsuka, and Toshizo Titani (Tokyo Metropolitan Isotope Center). Bull. Chem. Soc. Japan, 37: 931-4(July 1964).

The uptakes of the metal ions, Co^{2+}, Ca^{2+}, and Cs^+, by cotton cloth were determined by using the tracer technique. In the acidic and the neutral media, the isotherms were the Langmuir type, and the cation exchange mechanism of the special groups (probably the carboxyl group) was confirmed. The heat and the activation energy for the sorption of Co^{2+} were −2 kcal/mole and 7.6 kcal/mole, respectively (at pH ca 4.7). In the alkaline media, the cotton cloth showed marked uptakes. The order of the affinity of various metal ions to cotton cloth was also determined as follows: $Cu^{2+} > Zn^{2+} > Co^{2+} > Ca^{2+} > Sr^{2+} > Cs^+$, $K^+ > Na^+$. The order is useful for the purpose of decontamination. (auth)

35516 INFRARED-ACTIVE LATTICE VIBRATIONS IN A FEW FLUORITE-TYPE CRYSTALS. Minoru Terada and Masamichi Tsuboi (Mitsubishi Atomic Power Industries, Inc., Omiya, Japan and Tokyo Univ.). Bull. Chem. Soc. Japan, 37: 1080-1(July 1964).

Infrared absorptions of three metal oxides with fluorite-type lattices, namely, UO_2, ThO_2, and CeO_2 were observed in an attempt to obtain information about the crystalline force field. Each of the oxides showed only one strong absorption band in the spectral region 4000 ~ 200 cm^{-1}, which is what was expected from the crystal structure of these oxides. The metal-oxygen bond was strongest in UO_2, next strongest in ThO_2, and weakest in CeO_2. However, the metal-oxygen bond length was shortest in CeO_2. (P.C.H.)

35517 COLLOQUE CONSACRÉ A "L'ÉTUDE DES ACTES PRIMAIRES D'APPARITION ET D'ÉVOLUTION DES IONS EN PHASE GAZEUSE RARÉFIÉE" UNIVERSITÉ DE LIÈGE — OCTOBRE 1963. (Colloquim Devoted to a Study of the Primary Actions from the Appearance and Evolution of Ions in the Rarefied Gaseous Phase, University of Liège, October, 1963. Bull. Soc. Chim. Belges, 73: 303-458(May-June 1964).

Twelve articles are included; separate abstracts were prepared for 3. The 9 remaining articles not abstracted separately in NSA include information on: theoretical treatment of ionized molecules; ionization and dissociation energies of the hydrides and fluorides of the elements; production of the ionized state of molecules by high electric fields; temperature effects on ionization processes; new techniques for the study of ionization phenomena; molecular photoelectron spectroscopy; charge exchange phenomena; theories of unimolecular breakdown; and thermochemical studies by mass spectrometry. (P.C.H.)

For abstracts of individual papers see: 35518, 35519, and 35520.

35518 ISOTOPE EFFECTS IN THE PROCESS OF FRAGMENTATION OF TRIATOMIC MOLECULES. Florence Fiquet-Fayard (Faculte des Sciences, Paris). Bull. Soc. Chim. Belges, 73: 373-88(May-June 1964). (In French)

The results of studies on the isotope effects in the decomposition of deuterium labeled H_2O and H_2S by electron beams are presented. Difficulties encountered in the studies are discussed. The results showed that an important π effect and a bond between the kinetic energy of the fragments and the isotope effect both exist. (P.C.H.)

35519 ISOTOPE EFFECT IN FRAGMENTATION PROCESS OF MOLECULES SUBJECTED TO ELECTRON IMPACT. P. Natalis (Université, Liège). Bull. Soc. Chim. Belges, 73: 389-98(May-June 1964). (In French)

Main aspects of isotopic effects in fragmentation processes of molecules under electron impact are reviewed. These include: relative stability of D-labeled and non-labeled molecular species; relative probability of CH and CD bonds cleavage (Π and Γ effects); specific behavior of H and D atoms in migration processes; and qualitative aspect of kinetics of some decomposition reactions in

ionized molecules exhibited by metastable transitions. (auth)

35520 QUESTIONS RELATIVE TO IONIZATION OF MOLECULES BY PHOTONS OR ELECTRONS. J. E. Collin (Université, Liège). Bull. Soc. Chim. Belges, 73: 414-27 (May-June 1964). (In French)

A short survey of some of the most interesting and recent developments in ionization studies is presented. Special attention is given to such problems as vibrational structure of ionization curves, autoionization phenomena, anomalies in critical values for argon, meaning of ionization potentials, measurements on photoelectrons, and studies of dissociation by photoionization. (auth)

35521 THE DETERMINATION OF THE STABILITY CONSTANTS OF SOME LANTHANIDE-α-HYDROXYISOBUTYRATE COMPLEXES USING CATION EXCHANGE METHODS. H. Deelstra and F. Verbeek (Rijksuniversiteit, Ghent). Bull. Soc. Chim. Belges, 73: 597-614(May-June 1964).

The stability constants of some lanthanide-α-hydroxyisobutyrate complex systems were determined by cation exchange measurements. Fronaeus' method was used to calculate the consecutive formation constants of the terbium and thulium complex systems in 0.2 and 1 M ammonium perchlorate. The β_3 values of nine lanthanide complex systems were derived by Schubert's method. The formation constants determined by the cation exchange technique agree with the values found by potentiometric titration. (auth)

35522 THE LOW-TEMPERATURE ORDERED STATE OF CERIUM MAGNESIUM NITRATE AND ITS INFLUENCE ON NUCLEAR ORIENTATION. J. M. Daniels and J. Felsteiner (Univ. of Toronto). Can. J. Phys., 42: 1469-80 (Aug. 1964).

The method of Luttinger and Tisza for minimizing the dipole–dipole interaction energy is applied to cerium magnesium nitrate, and an antiferromagnetic ordering of the cerium spins at 0°K is found. Using this configuration, the magnetic field at the divalent ions is calculated. Next, the anisotropy of γ rays from ^{60}Co aligned in this salt is calculated for temperatures below 0.003°K. Qualitative agreement is found between these calculations and measurements of γ-ray anisotropy reported in the literature. (auth)

35523 THERMODYNAMICS OF NON-STOICHIOMETRIC URANIUM–OXYGEN SYSTEM. D. Jakes and L. Jakesova (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Prague). Collection Czech. Chem. Commun., 29: 1122-7(May 1964). (In German)

The results available on the thermodynamic measurements of the formation enthalpy of the nonstoichiometric phase of U(IV) oxide are discussed. On the basis of the results given in the literature, the free total enthalpy was calculated and used for the evaluation of the free enthalpies of the reduction reactions. (tr-auth)

35524 THE EXTRACTION OF URANYL NITRATE WITH DERIVATIVES OF PYRIDINE-N-OXIDE. A. V. Nikolaev, V. G. Torgov, V. A. Mikhailov, and I. L. Kotlyarevskii (Inst. of Inorganic Chemistry, Academy of Sciences, Siberian SSR). Dokl. Akad. Nauk SSSR, 156: 616-18 (May 21, 1964). (In Russian)

The interaction of pyridine–N–oxide $C_6H_5N \rightarrow O$ and its derivatives with uranyl salts leads to the formation of a strong $N \rightarrow O \ldots UO_2^{2+}$ bond. This bond is so strong that introduction of a strong electrophilic substituent (–Cl, $-C_6H_5$ or $-NO_2$) does not lead to a noticeable decrease in the strength of the bond. The general formula for the solvate is $UO_2(NO_3)_2 \cdot 2P_yO_x$, but this complex is poorly soluble in most organic solvents. The unsymmetrical α-alkylpyridine–N–oxides give compounds having the highest solubility. Lengthening of the alkyl side chain to C_5-C_9 leads to a further increase in solubility of the solvate in CCl_4 or $CHCl_3$. The distribution isotherm of the TBP and pyridine complexes with uranyl ion are similar. Various α-alkylpyridine–N–oxide derivatives in benzene or chloroform as a diluent exceed TBP in extractive ability by a factor of 100 to 200. The extraction of the pyridine complex increases on increasing the pH of the medium to ~3.6, and then decreases. This behavior indicates that a hydrolysis product of uranyl nitrate is being extracted. Further study showed that $UO_2(OH)(NO_3) \cdot 2P_yO_x$ was extracted at a uranyl concentration of 0.02 M at a high pH. (TTT)

35525 NOBLE-GAS COMPOUNDS. Neil Bartlett. Intern. Sci. Technol., No. 33, 56-62; 64; 66(Sept. 1964).

The prediction and verification of rare gas compounds are reviewed, together with the bases for the previous contention of no reaction in these gases. The structure and chemistry of rare gas compounds are then discussed, with particular emphasis on bonding theories. (D.C.W.)

35526 INVERSE SECONDARY INTERMOLECULAR ISOTOPE EFFECTS IN THE LOW-PRESSURE THERMAL ISOMERIZATION OF CYCLOPROPANE. B. S. Rabinovitch, P. W. Gilderson, and A. T. Blades (Univ. of Washington, Seattle and Research Council of Alberta, Edmonton, Can.). J. Am. Chem. Soc., 86: 2994-6(Aug. 5, 1964).

The experimental study of quantum statistical intermolecular secondary isotope effects in the rate of thermal decomposition of cyclopropane and of cyclopropane-d_6 was extended down to pressures of 10^{-4} mm. at 510°C by an internal comparison method. The expected inversion of the ratio $K(h_6)/k(d_6)$ occurs at $\sim 10^{-2}$ mm. Below this pressure complications attributed to wall effects obscure the behavior, and a limiting value of $k(h_6)/k(d_6) \simeq 0.8$ was obtained. The results are discussed briefly, along with mixed isotope effects, and are compared with theoretical computations. (auth)

35527 THE SECONDARY DEUTERIUM ISOTOPE EFFECT ON THE DIELS-ALDER REACTION. Dale E. Van Sickle and J. Otto Rodin (Stanford Research Inst., Menlo Park, Calif.). J. Am. Chem. Soc., 86: 3091-4(Aug. 5, 1964).

To gain further insight into the bond-forming processes of the Diels-Alder reaction and also to investigate the effect of slight reactant modification on the size of an α-deuterium isotope effect, competitive kinetics of maleic anhydride and maleic anhydride-d_2 with butadiene, cyclopentadiene, and anthracene were determined. The values of k_D/k_H per deuterium at 25°C are, respectively, 0.01, 1.03, and 1.05. The isotope effects (K_D/k_H) in the reaction of maleic anhydride with 1,3-butadiene-1,1,4,4-d_4 and anthracene-9,10-d_2 are 1.07 and 1.06 on a per deuterium basis at 25°C. The results are consistent with a four-center transition state that lies only a short distance along the reaction coordinate from the reactants. (auth)

35528 DETERMINATION OF SOLID-PHASE SEMICONDUCTORS OBTAINED FROM THE REDUCTION OF U_3O_8 BY HYDROGEN. Michel Murat, Maurice Chevreton, Gilbert Berodias, and Charles Eyraud (Faculte des Sciences, Lyon). J. Chim. Phys., 61: 812-15(June 1964). (In French)

The different phases appearing during the reduction of U_3O_8 by hydrogen between 400 and 900°C were identified by

measurements of electric conductivity and x-ray diffraction. The activation energies of the semiconductors obtained were determined from the electric conductivity curves. Structural and compositional information on the phases is tabulated. (D.C.W.)

35529 STRUCTURAL RELATION BETWEEN URANYL OXALATE AND ITS HYDRATES. René Bressat, Bernard Claudel, and Yves Trambouze (Institut de Recherches sur la Catalyse (C.N.R.S.), Villeurbanne, France). J. Chim. Phys., 61: 816-18(June 1964). (In French)

The three salts $UO_2C_2O_4$, $UO_2C_2O_4 \cdot H_2O$, and $UO_2C_2O_4 \cdot 3H_2O$ were determined to have monoclinic structure with closely related parameters. (D.C.W.)

35530 THE RELATIONSHIP BETWEEN SURFACE TENSION AND ENERGY OF LIQUID METALS AND THEIR HEAT OF VAPORIZATION AT THE MELTING POINT. Aristid A. V. Grosse (Temple Univ., Philadelphia). J. Inorg. Nucl. Chem., 26: 1349-61(Aug. 1964).

An empirical relationship between the surface tension and energy of liquid metals and their heat of vaporization at the melting point was presented recently. The relationship is a simple straight line between the logarithm of the surface tension at the melting point and the logarithm of the heat of vaporization per cubic centimeter of liquid metal at the melting point; the lower line relates to cubic or tetragonal melts while the higher line is for the hexagonal or rhombohedral metals. A rigorous demonstration of such relationships depends on the reliability and accuracy of all experimental data on which they are based. A critical review of all pertinent data on all metals available to date was made and is presented. It is also demonstrated that the free surface energy of metals at their melting point equals 15% of their heat of vaporization at the melting point. The various relationships are used to estimate unknown surface tensions and the specific examples of beryllium, lanthanum, and europium, at various temperatures (up to 3000°K), are discussed. (auth)

35531 PREPARATION OF URANIUM TETRAFLUORIDE BY THE THERMAL DECOMPOSITION OF HYDRAZINE URANYL FLUORIDE COMPLEXES. B. Sahoo and K. C. Satapathy (M. P. C. Coll., Baripada, India). J. Inorg. Nucl. Chem., 26: 1379-80(Aug. 1964).

Two hydrazine uranyl fluoride complexes possessing the composition, $UO_2F_2(N_2H_4HF)_3$, 1.5 H_2O and $UO_2F_2(N_2H_42HF)$, 1.25 H_2O, were prepared by crystallizing solutions of uranyl nitrate and hydrazine hydrofluoride in the ratio of 1:6 and 1:2, respectively. When the thermal decomposition of the former is carried out in vacuo at about 200°C, self reduction of uranium(VI) to uranium(IV) occurs and hydrazine uranium(IV) fluoride monohydrate complex $UF_4N_2H_4HF$, H_2O is obtained as an intermediate product. On raising the temperature to about 400°C further decomposition occurs and pure anhydrous uranium tetrafluoride is obtained as the final product. The latter hydrazine fluoride complex when heated in vacuum, yields directly uranium tetrafluoride in the anhydrous state. (auth)

35532 CRYSTALLINE AMMONIUM URANYL PEROXY-OXALATE. Y. Baskin and N. S. Krishna Prasad (Argonne National Lab., Ill.). J. Inorg. Nucl. Chem., 26: 1385-90 (Aug. 1964).

Single crystals of ammonium uranyl peroxy-oxalate $[(NH_4)_2UO_4C_2O_4 \cdot 3H_2O]$ were prepared. Crystallographic, powder diffraction and optical data are presented for the compound. Thermal decomposition of the compound was studied using differential thermal analysis and thermogravimetric analysis. Single-crystal x-ray studies revealed that the crystals became amorphous after prolonged exposure to unfiltered Cu radiation. Damage is attributed to the ionizing effect of the x-ray beam, which resulted in some decomposition of the compound. (auth)

35533 INFRARED AND RAMAN SPECTRA OF SEVERAL METALLIC HYPOPHOSPHITES. J. R. Ferraro and J. S. Ziomek (Argonne National Lab., Ill.). J. Inorg. Nucl. Chem., 26: 1397-9(Aug. 1964).

Infrared absorption measurements were made on the hypophosphites of UO_2(II), Th(IV), Sm(III), Tm(III), Yb(III), and La(III) in the region of 4000–250 cm^{-1}, and Raman spectra were obtained for Th(IV), Sm(III), and Yb(III) hypophosphites. It was found that these substances displayed characteristic bands similar to those reported for hypophosphites of univalent and divalent cations. The infrared band in the 460 cm^{-1} region, and the Raman band in the 930 cm^{-1} region, previously reported only for hypophosphites of univalent cations, are suggested as corroborating frequencies to be used with the bands at 2300–2400 cm^{-1} for characterizing the hypophosphite group. (auth)

35534 THE SOLUBILITY OF $U_3O_8 \cdot xH_2O$ IN PERCHLORIC ACID AT 25°C. K. H. Gayer, R. M. Haas, and L. C. Thompson (Wayne State Univ., Detroit). J. Inorg. Nucl. Chem., 26: 1401-3(Aug. 1964).

The solubility of $U_3O_8 \cdot xH_2O$ was measured in dilute perchloric acid solution and in water at 25°C. Apparently this oxide is unstable in sodium hydroxide solutions as evidenced by the color change from violet to a yellow resembling that of UO_3. (auth)

35535 THE DISTRIBUTION OF BISMUTH(III) AND POLONIUM(IV) BETWEEN TRILAURYLAMINE SOLUTIONS OF XYLENE AND HYDROCHLORIC AND HYDROBROMIC ACID SOLUTIONS. J. C. Sheppard (General Electric Co., Richland, Wash.) and R. Warnock. J. Inorg. Nucl. Chem., 26: 1421-7(Aug. 1964).

Distribution of bismuth(III) and polonium(IV) between hydrochloric and hydrobromic acids and trilaurylamine–xylene solutions indicates that $BiX_5(HAm)_2$ and $PoX_6(HAm)_2$ are found in the organic phase. An equation was derived that describes the features generally observed for this type of distribution equilibrium. The equation shows that the position of the distribution maximum is determined by the size of the formation constants of the aqueous complexes, the maximum coordination number of the aqueous complexes, and the acid to amine ratio in the organic phase. (auth)

35536 SORPTION OF ZIRCONIUM BY SILICA GEL FROM NITRATE MEDIUM IN THE PRESENCE OF OXALIC ACID, EDTA AND ARSENAZO I. R. Caletka, M. Kyrs, and J. Rais (Inst. of Nuclear Research, Czechoslovak Akademy of Sciences, Rez). J. Inorg. Nucl. Chem., 26: 1443-53(Aug. 1964).

The sorption of 10^{-6} M Zr on silica gel was studied in static and dynamic experiments in 1–5 N HNO_3 in presence of oxalic acid, EDTA, and Arsenazo I. The stability constants of the zirconium complexes with EDTA and oxalic acid were calculated from sorption experiments. Certain products of the reaction of Arsenazo I and nitric acid are shown to sequester zirconium stronger in 5 M HNO_3 than Arsenazo I. (auth)

35537 STABILITY CONSTANTS OF SCANDIUM(III) BROMIDE COMPLEXES. D. F. C. Morris, G. L. Reed, and K. J. Sutton (Brunel Coll., London). J. Inorg. Nucl., 26: 1461-2(Aug. 1964).

Stability constants for scandium bromide complexes in a perchloric–hydrobromic acid medium with an acidity

and ionic strength of 0.691 M were determined. The complexes were investigated by a cation exchange method with the ion exchange resin in the hydrogen form. Low values were obtained for the stability constants of scandium bromide complexes, which suggests that these species are probably outer sphere complexes. (P.C.H.)

35538 NUCLEAR MAGNETIC RESONANCE SPECTRUM OF THE FLUOROBERYLLATE ION. P. E. Francis and I. J. Lawrenson (National Chemical Lab., Teddington, Middx, Eng.). J. Inorg. Nucl. Chem., 26: 1462-3(Aug. 1964).

Further evidence for the existence and structure of the fluoroberyllate ion (BeF_4^{2-}) is reported. The NMR spectra consisted of a single quartet, all four components of which were equally intense. All the fluorine nuclei present are, therefore, equivalent. The quartet was produced by spin-coupling to the beryllium nucleus, which has spin quantum number $^3/_2$. The position of the quartet was 84.1 ± 0.6 ppm from an external reference of trifluoroacetic acid. The value of the F–Be spin-coupling constant was 33.7 ± 0.2 c/s. The width at half-height of each component of the quartet was about 24 c/s. (P.C.H.)

35539 COMPLEX FORMATION OF La(III), Eu(III), Lu(III), AND Am(III) WITH OXALATE, SULPHATE, CHLORIDE, AND THIOCYANATE IONS. Tatsuya Sekine (Royal Inst. of Tech., Stockholm). J. Inorg. Nucl. Chem., 26: 1463-5(Aug. 1964).

The complex formation of La(III), Eu(III), Lu(III), and Am(III) with oxalate, sulfate, chloride, and thiocyanate ions was studied by a distribution method at 25°C. The results showed that the stability constants of the La(III), Eu(III), and Lu(III) complexes do not always increase regularly with an increase in the mass number or with a decrease in the ionic size of the uncomplexed ions. The complexes of Am(III) were similar to those of Eu(III), except for the thiocyanate complexes. The stability of the complexes with different ligands decreased in the order oxalate > sulfate > thiocyanate > chloride. (P.C.H.)

35540 RARE EARTH HECTOBORIDES. P. Kent Smith and Paul W. Gilles (Univ. of Kansas, Lawrence). J. Inorg. Nucl. Chem., 26: 1465-7(Aug. 1964). (TID-20416)

During an investigation of the vaporization behavior and stability of lanthanide borides and lanthanide borocarbides, extremely boron-rich phases, called LnB_z, of composition near B/Ln = 100, were found in the Gd–B and Yb–B systems. The substances are black, crystalline, hard, and brittle; they are insoluble in most solvents except mineral acids, and melt at least as high at 2000°C. In ternary systems, they exist either with B_4C and boron or with B_4C and either GdB_6 or YbB_{12}. Both phases have a primitive cubic structure with the Gd and Yb parameters 16.50 ± 0.02 and 16.56 ± 0.01 Å, respectively. (P.C.H.)

35541 NITRATES OF URANIUM(IV), PLUTONIUM(IV), AND URANIUM(VI) IN TRI-N-BUTYL PHOSPHATE SOLUTIONS. J. L. Woodhead (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Inorg. Nucl. Chem., 26: 1472-3(Aug. 1964).

Evidence indicating that under suitable conditions, solvated complexes of the types $M(IV)OH(NO_3)_3$, $M(IV)(NO_3)_6^{2-}$ [M = Pu(IV) or U(IV)], and $UO_2(NO_3)_3^-$ occur in solutions of hydrated TBP was obtained. (P.C.H.)

35542 COMPOSITION AND STABILITY OF METAL-CHROMOTROPE 2B CHELATES OF SCANDIUM AND YTTRIUM. K. N. Munshi and A. K. Dey (Univ. of Allahabad, India). J. Inorg. Nucl. Chem., 26: 1603-6(Sept. 1964).

Spectrophotometric studies on the chelate formation between Sc(III) and Y(III) with p-nitrobenzene-azo chromotropic acid (trivial name Chromotrope 2B (CTB) are described. The λ_{max} of aqueous solutions of CTB is 515 mμ both at pH 4.5 and 6.0. The Sc chelate at pH 4.5 and Y chelate at pH 6.0 show the λ_{max} at 530 mμ with varying proportions of metal to CTB. The chelates have the same λ_{max} between pH 3.0 and 7.5 in the case of Sc–CTB and 3.5–9.5 in Y–CTB chelate, showing the pH range of stability of the chelates. The color formation is instantaneous and the absorbance values remain constant even up to 72 hr. No significant change occurs when the order of the addition of the reactants is altered. The Sc–CTB (pH 4.5) and Y–CTB (pH 6.0) complexes both form 1:1 complexes. (P.C.H.)

35543 MIXED OXIDES OF THE TYPE MO_2 (FLUORITE)–M_2O_3. I. OXYGEN DISSOCIATION PRESSURES AND PHASE RELATIONSHIPS IN THE SYSTEM CeO_2–Ce_2O_3 AT HIGH TEMPERATURES. D. J. M. Bevan and J. Kordis (Univ. of Western Australia, Nedlands). J. Inorg. Nucl. Chem., 26: 1509-23(Sept. 1964).

Oxygen pressures in equilibrium with the cerium oxides were determined by equilibration with CO/CO_2 or H_2/H_2O mixtures at temperatures from 636 to 1169°C. Partial and integral free energies, enthalpies, and entropies were calculated. The results were used to construct the cerium–oxygen phase diagram at these temperatures, between the compositions $CeO_{1.5}$ and $CeO_{2.0}$. (auth)

35544 THE STABILITY OF THE CHLORIDE COMPLEXES OF EUROPIUM. H. M. N. H. Irving and P. K. Khopkar (Univ. of Leeds, Eng.). J. Inorg. Nucl. Chem., 26: 1561-9(Sept. 1964).

The stability constant for the formation of $EuCl^{2+}$ was measured both by using a solid cation exchange resin and with a liquid cation exchanger and found to be 0.95 ± 0.15 at 20 ± 2°C and μ = 1.0 M. The evidence for higher complexes was examined critically. (auth)

35545 METAL NITRATES IN TRI-N-OCTYL AMINE NITRATE SOLUTION. J. M. P. J. Verstegen (Institutt for Atomenergi, Kjeller, Norway). J. Inorg. Nucl. Chem., 26: 1589-99(Sept. 1964).

The solubility of $Cu(NO_3)_2$, $Cd(NO_3)_2$, $Fe(NO_3)_3$, $UO_2(NO_3)_2$ and $Th(NO_3)_4$ was measured in 0.10, 0.050, and 0.025 M tri-n-octyl amine nitrate ($(TOAH)NO_3$) in various diluents. The ratio TOA/metal was calculated and the complex formation is discussed on the basis of some physical chemical properties. Water determinations were carried out in the amine layer. Some infrared data are reported and some tentative conclusions are drawn concerning polynuclear metal nitrate species in the amine phase. It is believed that the results illustrate that the extraction of metal nitrates does not necessarily need to be described as an ion exchange process. (auth)

35546 CHEMISTRY OF THE LANTHANONS. XIV. A NEW SERIES OF β-DIKETONATES OF Pr, Nd AND Y. N. K. Dutt (Indian Assn. for the Cultivation of Science, Jadavpur, India) and P. Bandyopadhyay. J. Inorg. Nucl. Chem., 26: 1610-12(Sept. 1964).

The formation and properties of compounds of composition $[Ln(OH)(H_2O)PnAc_2]$ where Ln represents Pr, Nd, and Y and PnAc represents the propionylacetonate ion are described. The corresponding La complex could not be isolated in the pure state. It was always found to be contaminated with the tris complex as indicated by analysis. On adding acids, these compounds may be assumed to form diaquo-bis-propionylacetonate of the form, $[Ln(H_2O)_2PnAc_2]^+$. Therefore, a solution of the hydroxo-

compound in aqueous acetone (the solvent used) containing one equivalent of a non-complexing acid like perchloric acid may be considered as containing $Ln(H_2O)_2PnAc_2^+$, which may further be titrated with the same acid and by following the pH of the solution, the successive instability constants can be determined. (P.C.H.)

35547 ON RARE EARTH–EDTA COMPLEXES. V. Amirthalingam and T. R. Bhat (Atomic Energy Establishment, Trombay, India). J. Inorg. Nucl. Chem., 26: 1612-14(Sept. 1964).

Studies were made to clarify discrepancies for EDTA complexes of Sm and Er. The preparative method described gave very powdery products and a different method was adopted for obtaining larger crystals suitable for single crystal x-ray studies in order to determine the crystal class, cell dimensions, and space group. The Sm-EDTA complex crystallized as light yellow prisms in the tetragonal system, with prominent (001) and less prominent (110) and (120) faces. The unit cell dimensions obtained from rotation and Weissenberg methods using CuK_α radiation are: a = 11.59 and c = 36.60 A. The Er–EDTA complex crystallized as light pink needles and tabular prisms belonging to the monoclinic system with prominent (001) and (120) end faces. The cell dimensions are: a = 11.74, b = 5.96, c = 12.11 A, and $\beta = 100°30'$. (P.C.H.)

35548 METAL HYDRIDE REACTIONS. I. REACTION OF HYDROGEN WITH SOLUTES IN LIQUID METAL SOLVENTS. P. Chiotti and P. F. Woerner (Ames Lab., Ames, Iowa). J. Less-Common Metals, 7: 111-19(Aug. 1964).

The precipitation of various solutes as hydrides from liquid metal solutions with hydrogen at one atmosphere pressure was investigated. The solutes considered were calcium, yttrium, lanthanum, cerium, and thorium and the solvents were magnesium, Mg-55 wt% Zn, Mg-30 wt% Al, and zinc. The residual concentrations of the above solutes in atom percent in magnesium at 650°C were found to be 5.6, 0.034, 2.9, 3.3, and 0.67, respectively. The residual concentration increases rapidly with an increase in temperature as expected from the free-energy data for the hydrides. The addition of a more electronegative component, such as zinc, to the magnesium also increases the residual concentration. The solubilities at various temperatures, under an inert gas, for yttrium in zinc, zirconium in aluminum, and thorium in Mg-30 wt% Al and in Mg-55 wt% Zn were measured. Hydrogen at one atmosphere pressure was found to have no detectable effect on the solubility of yttrium in zinc, or the solubility of zirconium in aluminum. The activity coefficients of the solutes in magnesium were calculated from data obtained. (auth)

35549 METAL HYDRIDE REACTIONS. II. REACTION OF HYDROGEN WITH $CaMg_2$ AND $CaCu_5$ AND THERMODYNAMIC PROPERTIES OF THE COMPOUNDS. P. Chiotti, R. W. Curtis, and P. F. Woerner (Ames Lab., Ames, Iowa). J. Less-Common Metals, 7: 120-6(Aug. 1964).

The equilibrium hydrogen pressure for the reaction $CaMg_2 + H_2 \rightleftharpoons CaH_2 + 2Mg$ was measured in the temperature range 450–637°C. The data below 517°C can be represented by $\log P_{H_2}$ (atm) = (–6919)/(T) + 5.95 and that above 517°C by $\log P_{H_2}$ (atm) = (–6666)/(T) + 5.56. The change in slope at 517°C is to be expected on the basis of a eutectic horizontal at this temperature. The data in the temperature range 450–517°C were combined with known thermodynamic data for calcium hydride to give the relations $\Delta F^\circ_{CaMg_2}$ = –10,624 + 4.28 T (440–517°C) and $\Delta F^\circ_{CaMg_2}$ = –9,735 – 2.46 T + 1.93 T log T (25–440°C). The equilibrium hydrogen pressure for the reaction $CaCu_5 + H_2 \rightleftharpoons CaH_2 + 5Cu$ was measured for the temperature range 492–648°C. The data can be represented by $\log P_{H_2}$ (atm) = (–6700)/(T) + 7.11. The data were combined with thermodynamic data for calcium hydride to obtain the relations $\Delta F^\circ_{CaCu_5}$ = –11,600 – 1.0 T (440–780°C) and $\Delta F^\circ_{CaCu_5}$ = –10,740 – 7.70 T + 1.93 T log T (25–440°C). (auth)

35550 ISOTOPIC FRACTIONATION OF HYDROGEN BETWEEN WATER AND THE AQUEOUS HYDROXIDE ION. Karl Heinzinger and Ralph E. Weston, Jr. (Brookhaven National Lab., Upton, N. Y.). J. Phys. Chem., 68: 2179-83 (Aug. 1964). (BNL-7797)

The fractionation of hydrogen isotopes between aqueous solutions of sodium hydroxide and potassium hydroxide and the vapor phase in equilibrium with the solutions was measured at 13.5°C. The separation factor thus obtained was used to calculate a value of 4.2 for the equilibrium constant, K_H, of the isotope exchange equilibrium $H_2O + OD^- = HDO + OH^-$. This value is in reasonable agreement with that obtained from spectroscopic data, and from other equilibria, including the ratio of ionization constants for light and heavy water. A comparison of values from different types of experiment permitted some conclusions concerning the hydration of the hydroxide ion to be made. (auth)

35551 ANION EXCHANGE OF METAL COMPLEXES. XIV. THE EFFECT OF ACIDITY ON THE SORPTION OF LANTHANIDES FROM LITHIUM NITRATE SOLUTIONS. Y. Marcus and M. Givon (Israel Atomic Energy Commission, Yavne). J. Phys. Chem., 68: 2230-4(Aug. 1964).

Activity coefficients of small concentrations of nitric acid in 1–8 m lithium nitrate were determined potentiometrically, using quinhydrone and glass electrodes. The invasion of a Dowex 1 resin by nitric acid and lithium nitrate from a 3.90 m total nitrate solution was measured. Activity coefficients of nitric acid in the resin were calculated. The acidity dependence of the distribution of La, Eu, Yb, and Am between resin and a lithium nitrate solution was measured. Sorption of the species $M(NO_3)_5^{-2}$, for M = Eu, Yb, and possibly Am, and $La(NO_3)_7^{-4}$ was found to be consistent with the experimental data. (auth)

35552 KINETICS OF REACTION OF ELEMENTAL FLUORINE. II. THE FLUORINATION OF HAFNIUM CARBIDE AND HAFNIUM BORIDE. A. K. Kuriakose and J. L. Margrave (Rice Univ., Houston, Tex.). J. Phys. Chem., 68: 2343-5(Aug. 1964).

The corrosion kinetics of high purity hafnium carbide and hafnium diboride in elemental fluorine under low fluorine partial pressures (2.8–52.5 torr) in helium were investigated up to 890°C for HfC and 1020°C for HfB_2. Although HfC produces solid hafnium tetrafluoride from 300 to 500°C, the tetrafluoride does not adhere to the HfC. HfB_2, on the other hand breaks down in the same temperature range, apparently because of reaction at pre-existing cracks when the fluorine partial pressure is 13 torr. Due to the volatility of the fluorides around 600°C, both HfC and HfB_2 begin to lose weight in fluorine with linear reaction rates and the samples stay unbroken even to the highest temperatures examined in this investigation. The reactions are highly exothermic and the surface temperatures of the samples increase rapidly, almost proportionally to the fluorine partial pressure in the system, as fluorine is admitted. For HfC the reaction rate varies directly as the fluorine partial pressure while for HfB_2 it varies directly as the square root of fluorine pressure. A comparison of the behavior of the carbides and diborides of zirconium and hafnium toward fluorine is given. (auth)

35553 A TORSION EFFUSION STUDY OF THE REACTION OF GRAPHITE WITH OXIDES OF THORIUM AND

ZIRCONIUM. John R. Hollahan and N. W. Gregory (Univ. of Washington, Seattle). J. Phys. Chem., 68: 2346-51 (Aug. 1964).

The torsion effusion method was found to give useful results for the study of the solid–solid reaction between ThO_2 and graphite, which produces ThC_2 and CO. Near equilibrium pressures do not appear to be established for the reaction of graphite with ZrO_2. however. Thermodynamic properties of ThC_2 are discussed. (auth)

35554 THE NEAR-INFRARED TRANSITIONS OF THE TRIVALENT LANTHANIDES IN SOLUTION. III. PROMETHIUM(III). W. T. Carnall, P. R. Fields, and G. E. Toogood (Argonne National Lab., Ill.). J. Phys. Chem., 68: 2351-7 (Aug. 1964).

The solution absorption spectrum of Pm^{3+} was measured both in molten $LiNO_3$–KNO_3 eutectic at 150°C in the range 0.35–2.6 μ and in dilute DCl at 25°C in the range 0.35–1.8 μ. The results give the first experimental confirmation of calculations, which place the two highest levels of the ground term multiplet, $^5I_7$ and $^5I_8$, within the region of transparency of the nitrate melt in the near-infrared. A full intermediate coupling calculation for the f^4 configuration was also carried out, and all energy levels from 0 to 30,000 cm^{-1} are reported, based on the following values of the Slater integrals: F_2 = 351 cm^{-1}, F_4 = 47.7 cm^{-1}, F_6 = 5.30 cm^{-1}, and on a spin–orbit coupling constant, ζ = 1030 cm^{-1}. Interpretation of the results in the visible region is offered based on these calculations and on recent theoretical treatments of the intensity of lanthanide spectra. A very intense transition of Pm^{3+} in the visible region in molten nitrate solvent was discovered, and this should aid in the analysis of the element in mixtures. (auth)

35555 MASS SPECTROMETRIC STUDY OF PHOTOIONIZATION. I. APPARATUS AND INITIAL OBSERVATIONS ON ACETYLENE, ACETYLENE-d_2, BENZENE, AND BENZENE-d_6. Vernon H. Dibeler and Robert M. Reese. J. Res. Natl. Bur. Std., 68A: 409-17(July-Aug. 1964).

A windowless vacuum uv monochromator and mass spectrometer were combined to study photoionization processes in the energy range from 600 to 2000 Å (6 to 21 ev). Details of the apparatus and techniques of operation are given, and results are reported for an initial study of acetylene, acetylene-d_2, benzene, and benzene-d_6. Ionization energies of 11.406 and 11.416 ev are obtained for the $1\pi_u$ electron of C_2H_2 and C_2D_2, respectively. Vibrational levels of the ground state of the ion are observed with quantum intervals of 1855 cm^{-1}(C_2H_2) and 1775 cm^{-1}(C_2D_2). Ionization energies for the $e_{1g}(\pi)$ electron of C_6H_6 and C_6D_6 are determined to be 9.24_2 and 9.24_5 ev, respectively. Quantum intervals for vibrational levels of the ground state ions are apparently equal for the two isotopic molecules and are estimated to be 800 cm^{-1}. A second onset of ionization is observed at 11.5_3 ev for C_6H_6 and at 11.5_9 ev for C_6D_6. The results agree well with spectroscopic data. (auth)

35556 THE VIBRATIONAL SPECTRA OF AROMATIC COMPOUNDS. XIX. CALCULATION AND INTERPRETATION OF THE VIBRATIONAL SPECTRA OF NAPHTHALENE AND SOME DEUTERIONAPHTHALENES. E. P. Krainov. Opt. Spectr. (USSR) (English Transl.), 16: 415-17(May 1964). Translated from Opt. i Spektroskopiya, 16: 763-7(May 1964).

A calculation of vibration frequencies, force constants, and interaction coefficients was carried out for naphthalene $C_{10}H_8$ (d_0) and the deuterionaphthalenes: α-$C_{10}H_4D_4$ (α-d_4), β-$C_{10}H_4D_4$ (β-d_4), and $C_{10}D_8$ (d_8). An interpretation of the vibrational spectra of these molecules is given, and the characteristics of the force field of the naphthalene molecule are clarified. (auth)

35557 MAGNETIC PROPERTIES OF SOME RARE-EARTH PHOSPHIDES. G. Busch (Eidgenössische Technische Hochschule, Zurich), P. Schwob, O. Vogt, and F. Hulliger. Phys. Letters, 11: 100-1(July 15, 1964).

The magnetic moments of TbP, DyP, HoP, and ErP were measured. The paramagnetic Curie temperature and the effective number of magnetons were derived from the inverse susceptibility versus temperature curves. (C.E.S.)

35558 DIRECT EVIDENCE FOR COOPERATIVE PROTON TUNNELING IN THE SOLID STATE. G. Aiello, M. U. Palma, and F. Persico (Università, Palermo, Italy). Phys. Letters, 11: 117-19(July 15, 1964).

The possibility that a tunneling of the H^+ ions among different equilibrium positions in the solid state may occur in a co-operative was considered. Results of ESR measurements that yield direct evidence for a cooperative tunneling of the H^+ ions in crystals are reported. The crystals considered were $NiCl_2 \cdot 6NH_3$. ESR experiments were also performed on the Ni^{2+} ions in crystals containing 50% H and 50% D. (C.E.S.)

35559 NUCLEAR MAGNETIC RESONANCE MODES IN MAGNETIC MATERIALS. II. EXPERIMENT. G. L. Witt and A. M. Portis (Univ. of California, Berkeley). Phys. Rev., 135: A1616-18(Sept. 14, 1964).

The indirect coupling of nuclei through spin waves in ordered magnetic materials can give rise to a mixing of the nuclear-electronic resonance modes. The results of an experimental investigation of this effect in antiferromagnetic $KMnF_3$ are described. The mixing of modes permits ^{55}Mn nuclear magnetic resonance absorption to be detected indirectly by monitoring the antiferromagnetic resonance. Such nuclear absorption was observed for a range of frequencies between 570 and 685 Mc at 4.2°K. (auth)

35560 NUCLEAR POLARIZATION IN EuS AND Eu. L. Passell, V. L. Sailor, and R. I. Schermer (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 135: A1767-70 (Sept. 14, 1964). (BNL-7986)

Transmission experiments were carried out with polarized, monochromatic neutrons and polarized ^{151}Eu nuclei using samples of EuS and Eu metal. It is found that the hyperfine field in both cases is negative. (auth)

35561 ON THE QUANTUM STATISTICAL THEORY OF RELAXATION IN ISOLATED SPIN SYSTEMS. [PART] II. J. A. Tjon (Rijksuniversiteit, Utrecht). Physica, 30: 1341-64(July 1964).

The previous investigation of the irreversible behavior of an isolated spin system is continued. The question is studied in how far and in which way the transverse magnetic moments have to be taken into account for a correct description of the long time behavior of the spin system. All the results obtained previously for the longitudinal magnetic moment are reproduced under the condition that the perturbation is spherically symmetrical in space. In order to determine the time corrections on the long time behavior a formal solution is derived for the correlation tensor, valid for all times. It is shown that in the limit $t \to \infty$ this expression yields a value, which is well in accordance with the predictions of microcanonical theory. In this connection the problem of the equivalence of the isolated and adiabatic susceptibilities is discussed. Furthermore, with the help of the formal solution for the correlation tensor, the line spectrum and line shapes

are determined in parallel and perpendicular fields for several special cases. (auth)

35562 THE DEPENDENCE OF THE ANISOTROPIC KNIGHT SHIFT ON CRYSTAL SYMMETRY. M. H. Boon (Battelle Memorial Inst., Geneva). Physica, 30: 1326-40 (July 1964).

The magnetic field at a nucleus in a metal due to the electron-nuclear spin dipole interaction produces the anisotropic Knight shift. It is shown that, in the absence of spin-orbit and electron spin-spin dipole coupling terms, the shift is zero in cubic materials as a general group-theoretical consequence of symmetry, and that no specific assumptions need be made about the electron wave functions such as they are p-like or d-like etc. as in previous discussions. Neglecting the same terms, the formulas for the angular dependence of the shift on the orientation of the magnetic field relative to crystallographic axes are derived for single crystals of the six non-cubic systems. These results are obtained with an independent-particle model for the conduction electrons, but it is found that they are unaffected if the Coulomb interactions are taken fully into account. An expression is given for the anisotropic Knight shift with spin-orbit coupling included in a certain approximation. Diamagnetic effects are neglected throughout. (auth)

35563 A COMPENSATORY EFFECT IN THE REACTION KINETICS OF THE ACTINIDES. V. P. Kazakov, B. I. Peshchevitskii, and A. M. Erenburg. Radiokhimiya, 6: 291-8(1964). (In Russian)

A plot of the heat of activation ΔH^* versus the entropy ΔS^* for various actinide reactions showed that these two terms are not independent of each other. An increase in the heat of activation is always accompanied by an entropy increase, and this behavior leads to a smaller change in the reaction rate constants than would be expected, if this relationship did not exist. This effect is similar to the compensatory effect observed for heterogeneous catalytic reactions by Constable (Proc. Roy. Soc., A108: 355(1926)). The linear relation between the enthalpy and entropy can be expressed by the following equation: $\Delta S_0 = \nu\Delta H_0$. Values of ΔH were plotted against ΔS for various oxidation-reduction reactions and complexing reactions for various ions of U, Np, Pu and Am. These data lie on a straight line, and may be used to estimate the value of ΔS_0 or ΔF_0 from the enthalpy value of a reaction. The reaction rate constants of the actinides are nearly the same in value at room temperature, and this fact explains the coexistence of a number of oxidation states of the actinide elements in aqueous solution at room temperature. This behavior also makes it possible for a number of parallel reactions to take place simultaneously. (TTT)

35564 THE INFRARED SPECTRA OF URANYL PERCHLORATE AND ITS HYDRATES. THE COORDINATION OF THE PERCHLORATE ION. V. M. Vdovenko, L. G. Mashirov, and D. N. Suglobov. Radiokhimiya, 6: 299-305 (1964). (In Russian)

The infrared spectra of $UO_2(ClO_4)_2$, $UO_2(ClO_4)_2 \cdot H_2O$, $UO_2(ClO_4)_2 \cdot 3H_2O$, $UO_2(ClO_4)_2 \cdot 5H_2O$, and $UO_2(ClO_4)_2 \cdot 7H_2O$ were measured over a region of 400 to 4000 cm^{-1} in order to detect a decrease in symmetry of the ClO_4^- ion due to covalent bonding of ClO_4^- with a cation through one or two oxygen atoms. The close analogies in the spectra between ClO_4^- and SO_4^{2-} were used in determining the assignment of frequencies. The number of frequency bands of ClO_4^- in spectra of $UO_2(ClO_4)_2 \cdot 7H_2O$ and $UO_2(ClO_4)_2 \cdot 5H_2O$ points to the presence of an uncoordinated perchlorate ion. The appearance of a ν_1 band, which is a forbidden absorption for a symmetrical ClO_4^-, and the broadening of a ν_3 band in the spectra of $UO_2(ClO_4)_2 \cdot 7H_2O$ and $UO_2(ClO_4)_2 \cdot 5H_2O$ is due to the formation of a hydrogen bond between ClO_4^- and hydration water coordinated to the uranium atom. This view is confirmed by the appearance of the spectrum of hydrated water in the region of the valence OH-vibrations. The presence of six, well-resolved, intense, ClO_4^- bands in the $UO_2(ClO_4)_2 \cdot 3H_2O$ spectrum, and of nine bands in the spectra of $UO_2(ClO_4)_2 \cdot H_2O$ and $UO_2(ClO_4)_2$ indicates that the symmetry of the ClO_4^- anion has been decreased to C_{3v} and C_s respectively, and this behavior is related to the coordination of ClO_4^- to uranium through one or two oxygen atoms. It was concluded that the coordination number of the uranyl ion is equal to five in the uranyl perchlorate hydrates. (TTT)

35565 A STUDY OF THE ISOTOPIC EXCHANGE OF THE CHLORINE ATOM IN THE DICHLORAMIDE GROUP WHICH IS A PART OF A Pt(IV) COMPLEX. Yu. N. Kukushkin and A. F. V'yugina. Radiokhimiya, 6: 336-42 (1964). (In Russian)

Since the chlorine atom in the $[Pt(NH_3)_5Cl]^{3+}$ complex does not undergo isotopic exchange at room temperature, one of the ammonia groups was replaced by a dichloramide group, and isotopic exchange of chlorine was investigated with the $[(NH_3)_4ClPtNCl_2]^{2+}$ ion. The β-emitter ^{36}Cl with a half life of 4.4×10^5 years was used as the tracer. The results of the exchange experiments show that the pH of the solution has an effect on the exchange rate. With Pt(IV) concentration of 1.0×10^{-2} M and a chloride ion concentration of 4.78×10^{-2} g-ion/l, the time for 50% exchange of the chloride ion was 15 min at a pH of 2.0, 54 min at a pH of 2.55, and 174 min at a pH of 3.15. The isotopic exchange of chlorine is first order with respect to hydrogen ion concentration. The experimental results also showed that the isotopic exchange of chlorine is first order with respect to the concentration of the Pt(IV) complex, and chloride ion concentration. The isotopic exchange rate can be expressed by the following relationship: $R = K_1[(NH_3)_4ClPtNCl_2]^{2+}[Cl^-] \cdot [H^+]$ with a rate constant $K_1 = 1.2 \pm 0.1$ $l^2 \cdot g\text{-}ion^{-2} \cdot sec^{-1}$ at 25°C. The rate constant is given as a function of temperature by the following equation: $K = 6.7 \times 10^{11} \exp(-17{,}400/RT)$. A mechanism is proposed, where a H^+ ion is added to the Pt(IV) complex, and exchange of the chlorine atom in the dichloramide group takes place by direct replacement in the positively charged complex. (TTT)

35566 REGULARITIES IN THE TRANS EFFECT OF I. I. CHERNYAEV. Yu. N. Kukushkin and A. F. V'yugina. Radiokhimiya, 6: 342-7(1964). (In Russian)

The trans-effect rule established by Chernyaev in 1926 states that the reaction rate for the replacement of an atom or molecules in a square planar complex or in an octahedral complex is determined by the nature of the ligand occupying the opposite end of the diagonal. The isotopic exchange of chlorine atoms in the dichloramine groups was compared in compounds of the type $[Pt(NH_3)_4NCl_2X]^{2+}$, where X stands for a Cl or Br atom. The exchange rate of chlorine with the $Cl-Pt-NCl_2$ grouping was 50% faster than with the $Br-Pt-NCl_2$ grouping (1.2 ± 0.1 compared to 0.77 ± 0.05 $l^2 \cdot g\text{-}ion^{-2} \cdot sec^{-1}$ for the reaction rate exchange constants). Since the polarizability of the bromine atom is greater than that of the chlorine atom, the difference in the isotopic exchange rates of chlorine in $[Pt(NH_3)_4NCl_2Br]^{2+}$ and in $[Pt(NH_3)_4NCl_2Cl]^{2+}$ is a result of the difference in the trans-effect of bromine compared to chlorine. (TTT)

35567 VIBRATORY SPECTRA OF ZIRCONIUM COMPLEXES CONTAINING PHOSPHOORGANIC DERIVATIVES. III. THE SPECTRA OF ZIRCONIUM EXTRACTS FROM STRONG NITRIC ACID SOLUTIONS. G. P. Nikitina and M. F. Pushlenkov. Radiokhimiya, 6: 347-60(1964). (In Russian)

The composition and structure of zirconium compounds extracted from a strong HNO_3 solution (8.0, 12.34 and 16.85M) into an organic solution of TBP or TBPO in CCl_4 were determined by chemical analysis and by a study of the infrared spectra of the organic extracts. The results show that at acidities below 8N HNO_3, zirconium is extracted in the form of a $Zr(NO_3)_4 \cdot 2T$ complex, where T represents a solvent molecule addend. At acidities >12 N, the composition of the zirconium complex corresponds to the formula $Zr(NO_3)_4(HNO_3)_m \cdot 2T$, where m = 1 for a 12.34N HNO_3 solution, and m = 4 for a 16.85N HNO_3 solution. On the basis of an analysis of the infrared spectra, it was concluded that the zirconium in the extracted complex has a coordination number of 6. Four of the coordination positions are occupied by nitrate groups, and two are occupied by phosphoryl groups. The HNO_3 molecules add to the zirconium complex by hydrogen bonding to oxygen of the nitrate groups. A total of 4 HNO_3 molecules can be added in the second coordination sphere. (TTT)

35568 PREPARATION OF CHLOROBENZENE TAGGEI WITH RADIOACTIVE ^{36}Cl BY MEANS OF ISOTOPIC EXCHANGE. A. N. Bantysh, Ya. D. Zel'venskii, and V. A. Shalygin. Radiokhimiya, 6: 367-71(1964). (In Russian)

It was found that CuO, Cu, Cu_2O, and Ag_2O were effective as catalysts in promoting exchange between $Na^{36}Cl$ and C_6H_5Cl at 195°C, but CuO was the most effective of the catalysts. $Li^{36}Cl$ was substituted for $Na^{36}Cl$ because of the greater solubility of $Li^{36}Cl$ in methyl alcohol. A total of 0.1 to 0.3 g of CuO catalyst is required per 5 g of C_6H_5Cl. The isotopic exchange rate is first order with respect to the reactants as described by the following equation: $R = K\gamma_{LiCl}\gamma_{C_6H_5Cl}[LiCl][C_6H_5Cl]$. Here, γ_{LiCl} and $\gamma_{C_6H_5Cl}$ are activity coefficients. The isotopic exchange between $Li^{36}Cl$ and chlorobenzene in methyl alcohol solution can be carried out in a sealed stainless steel vessel designed to hold 100 atm pressure. In completing the isotopic exchange, the temperature is held at 215°C for 40 hours, or at 240°C for 9 hours. In order to obtain chlorobenzene with a high specific activity, the ratio of $Li^{36}Cl$ to C_6H_5Cl is selected so that 50% of the initial activity in the $Li^{36}Cl$ is transferred to the C_6H_5Cl after complete exchange. The chlorobenzene is recovered by distillation. (TTT)

35569 A PROPOS OF THE ARTICLE BY B. Z. IOFA AND G. M. DAKAR (RADIOKHIMIYA 5, 490(1963) No. 3) "THE EXTRACTION OF COMPLEX ACIDS BY OXYGEN-CONTAINING SOLVENTS. II. CALCULATION OF THE EQUILIBRIUM CONSTANT OF THE HYDROLYSIS OF ANTIMONY (V) IN HYDROCHLORIC ACID SOLUTIONS AND INVESTIGATION OF THE MECHANISM OF ITS EXTRACTION BY DI-n-BUTYL ESTER." V. V. Fomin. Radiokhimiya, 6: 378-80(1964). (In Russian)

A previous review was made on the equilibrium of the extraction of Sb from HCl-containing solutions. This equilibrium is controlled by a slow shift of the equilibrium of the hydrolysis in the aqueous phase. An equilibrium was established at least at acid concentrations of 9 to 10 M in the aqueous phase between $SbCl^-$ and the first product of the hydrolysis, $SbCl_5OH^-$. Using the previous experimental results, an attempt was made to calculate the constants of the hydrolysis, even though the values referred to non-equilibrium conditions. The derivations are incorrect; the value of the factor $\alpha_2 = 1$ is correct only for the original aqueous solution. It was concluded that even though an interesting contribution was made by using kinetic data for the equilibrium constant of the reaction taking place in the aqueous phase, the theoretical treatment of the data is faulty and any agreement with values reported by others is strictly coincidental. (TTT)

35570 ON THE PRESSURE OF SATURATED HEAVY WATER VAPOR. N. I. Mel'nichenko (Moscow Automechanical Inst.). Teploenergetika, No. 6, 63-4(June 1964). (In Russian)

An analytical description is given of universal experimental data on the pressure of saturated heavy water for a large range of temperatures. (tr-auth)

35571 INTERACTION OF CARBON WITH CARBON DIOXIDE AT HIGH TEMPERATURES. E. S. Golovina and G. P. Khaustovich. Teplofiz. Vysokikh Temp., 2: 267-73 (1964).

Spherical specimens (1.5 cm in diameter) of graphitized carbon (EG-14 brand) were heated in a carbon dioxide–nitrogen atmosphere at 1300–3200°K, 1 atm pressure, 25, 50, and 100% CO_2 concentration, and gas velocities of 0.2–0.8 m/sec to study the interaction of solid carbon with CO_2 at high temperatures and to determine the reactivity of carbon in the $C + CO_2$ reaction. Specific reaction rate K_s ($kg/m^2 \cdot sec$), and gas-exchange coefficient α_{21}, were determined for the reaction over the studied temperature, concentration, and velocity ranges. Visual observation showed that in the temperature range of 1300–1800°K, the reaction is accompanied by the separation of a thin scale of carbon detaching from the specimen; at 1800–2300°K it is accompanied by the detachment of glowing, fine carbon dust. The weights of the scale and of the dust were determined as a function of the reaction conditions, and the data were used in determining K_s values. The results showed that at temperatures up to 2600°K, there is a considerable decrease in both the weight and the diameter of the specimen, while the specific gravity remains practically unchanged; at temperatures above 2600°K, the specific gravity decreases, while the diameter remains practically unchanged. Thus, at lower temperatures the reaction occurs in the surface layer by diffusion of CO_2 into solid carbon, and at higher temperatures the diffusion of carbon atoms takes place from the interior to the surface of the carbon specimen. Below 1800°K the $C + CO_2$ interaction is not a first order reaction and above 1800°K it is of first order for all CO_2 concentrations studied. A comparison of the theoretical and experimental temperature dependence curves of K_s and α_{21} showed that the experimental data obtained are in disagreement with the existing theory. The effective activation energy of the $C + CO_2$ reaction at 1300–1700°K was found to be 60,000 cal/molecule. (TCO)

35572 RESEARCH ON POSSIBLE USES OF INORGANIC ION EXCHANGERS. H. J. Riedel (Kernforschungsanlage, Julich, Ger.). p.252-8 of "Atomstrahlung in Medizin und Technik." Munich, Verlag Karl Thiemig KG, 1964. (In German)

The properties of the phosphate, molybdate, and tungstate of zirconium as synthetic ion exchangers were studied systematically. Typical results obtained on the cation distribution coefficients, the dependence of the K_D value on the hydrogen ion concentration, and selectivity coefficients are reported. (J.S.R.)

35573 THE EFFECT OF VERY HIGH PRESSURES ON THE MÖSSBAUER SPECTRUM OF Fe^{57} IN IRON METAL. Malcolm Foertner Nicol. Thesis, Berkeley, Calif., Univ. of California, 1963. 77p.

A velocity-sweep type high-pressure Mössbauer spectrometer developed for use at pressures to 150 kbar and greater was used to study the effect of pressure on the Mössbauer spectrum of ^{57}Fe in metallic iron to a pressure presumably higher than 140 kbar. At pressures up to 120 kbar, a six-line spectrum characteristic of α-iron was observed. A seventh line appeared in the spectrum obtained at 140 kbar. This line was attributed to the appearance of the high-pressure phase of iron. The variation of the magnetic splitting of the Mössbauer spectrum in the α-iron phase compared favorably with results obtained at lower pressures by nuclear magnetic resonance. The experiment indicates that Mössbauer spectroscopy can be usefully applied to the study of magnetic materials at high pressures, and some additional experiments are suggested. (Dissertation Abstr., 24: No. 12, Pt. I (June 1964))

35574 THE STUDY OF DEUTERIUM CONCENTRATION IN METAL FOILS BY MEANS OF THE D(d,p)H^3 REACTION. James M. Hemstreet. Thesis, Baton Rouge, La., Louisiana State Univ., 1963. 57p.

Deuterium concentration in several metals was studied by means of the D(d,p)H^3 reaction for deuteron energies varying from 20 to 80 kev. Rough comparisons were made with other experiments, and calculation of density and density distribution functions were carried out from cross section data for the (d,d) reaction. Values of density range from approximately 10^{21} for Au to 10^{22} atoms/cm^3 for Cu. These values are compared with those computed from considerations of time exponential saturation curves. A method, utilizing the proton pulse height spectra and deduced range-energy relations, devised for finding relative density distributions was applied to Ag. (Dissertation Abstr., 24: No. 12, Pt. I (June 1964))

35575 THE MECHANISM OF ELECTROLYTIC HYDROGEN EVOLUTION—AN ISOTOPE EFFECT STUDY. Supramaniam Srinivasan. Thesis, Philadelphia, Univ. of Pennsylvania, 1963. 336p.

The separation factor method was used to determine the mechanism of hydrogen evolution. A technique was developed for the measurement of the H/T separation factor S_T, using Cu and Hg as test electrodes in 0.5N H_2SO_4. The method was applied to the metals Pt, Rh, W, Ni, Cd and Pb in 0.5N H_2SO_4 and Pt, W, Ni and Pb in 0.5N NaOH, on which metals overpotential measurements were carried out prior to the separation factor determinations to check the purity of the system. The experimental S_T values, in acid solution, fall into 3 groups: 6–7 on Hg, Pb and W; 9–11 on Pt, Rh and Cd; 16–18 on Cu and Ni. In alkaline solution, Ni, W and Pb gave S_T values of 4–7 and S_T on Pt is 15–16. The theoretical calculations of S_D by Horiuti et al. and by Conway were examined. The calculation procedure by Horiuti et al. was adopted. By inclusion of the contribution of the real stretching vibration of the linear transition state, separation factors for the slow discharge mechanism corresponded to the experimental values on the high overpotential metals and Ni in alkaline solution. The theoretical values on Ni for the slow electrochemical desorption mechanism is in agreement with the experimental results on Ni and Cu in acid solution and Pt in alkaline solution. At high overpotentials, when the reverse of the discharge and electrochemical desorption steps may be neglected, separation factors cannot distinguish between slow discharge and slow electrochemical desorption mechanisms. The only way of distinguishing the two mechanisms is by a determination of the degree of coverage of atomic hydrogen. The experimental results on W in acid and alkaline solution are interpreted as a rate-determining electrochemical desorption mechanism. S_T is 8.2 for a slow molecular hydrogen diffusion mechanism and is independent of the metal. This mechanism thus cannot explain small changes in S_T values observed on Pt and Rh. Secondary isotope effects due to HT/H_2O interchange reactions play a role only in the case of a slow discharge followed by a fast electrochemical desorption mechanism at low overpotentials. (A.G.W.)

35576 OXYGEN ISOTOPE FRACTIONATION IN THE SYSTEM QUARTZ–WATER. Robert Lawrence Wershaw. Thesis, Austin, Tex., Univ. of Texas, 1963. 104p.

The apparent oxygen isotope fractionation factor for the reaction: 1/2 SiO_2^{16} (quartz) + H_2O^{18} = 1/2 SiO_2^{18} (quartz) + H_2O^{16} was measured as a function of temperature from 173°C to 533°C. This was accomplished by synthesizing quartz from dried silicic acid in aqueous solutions of known oxygen isotopic composition under controlled conditions of temperature and pressure. After the quartz was grown, the oxygen was extracted from it by carbon reduction. The carbon dioxide obtained from the reduction was analyzed on a 9-inch inflection-point focusing, dual-collector mass spectrometer. The isotopic fractionation factor was also calculated from Raman and infrared spectral data. The quantum statistical model of a crystal used for this calculation is a combination of the Debye model and the Einstein model. The calculated equilibrium constants are in good agreement with the measured ones for temperatures from 400°C to 533°C. For temperatures below 400°C the experimentally measured fractionation factors diverge more and more from the calculated ones. This indicates that isotopic equilibrium was not attained in the runs made below 400°C. A brief discussion is given of the application of oxygen isotope measurements to geologic problems. (Dissertation Abstr., 24: No. 12, Pt. I (June 1964))

35577 LIQUID-VAPOR EQUILIBRIUM IN THE SYSTEM NORMAL HYDROGEN–HELIUM. William Bernard Streett, Jr. Thesis, Ann Arbor, Mich., Univ. of Michigan, 1963. 149p.

Experimental vapor and liquid phase composition are presented for the binary system normal hydrogen–helium, covering the temperature range 15.50–32.50°K and pressures up to 500 psia. The critical curve is located in the temperature range 30.6–32.5°K. The behavior of the system, as described by P-x, T-x, and P-T plots, is typical of binary systems in which the critical points are far apart. The experimental equipment consists of a vapor recirculating equilibrium system with a vapor pressure-controlled liquid hydrogen bath. Temperatures were controlled to within ±0.02°K, or better, and measured with a platinum resistance thermometer. Pressures were measured to within ±0.5 psi with a 0–500 psig calibrated 16-inch Heise Gage. A detailed description of the construction and operation of the equipment is included. A comparison of the experimental results with previous work is given, and conflicts in existing data are resolved. The problems of rigorous thermodynamic analysis of the data are briefly discussed. (Dissertation Abstr., 24: No. 12, Pt. I (June 1964))

35578 CARBON ISOTOPE EFFECTS IN MALONIC ACID DECARBOXYLATION. I. INFLUENCE OF PERDEUTERATION. II. THE IONIZATION EFFECT. William George Koch. Thesis, Urbana, Ill., Univ. of Illinois, 1963. 196p.

The effect of perdeuteration on the intramolecular kinetic carbon-13 isotope effect in the decarboxylation of liquid malonic acid at 140.5°C was investigated. The $^{13}C/^{12}C$ ratios in the carbon dioxide and the acetic acid produced

by complete decarboxylation were determined by mass spectrometry. A commercially available sample of malonic acid-d_4 was decarboxylated after each of the following treatments: the original sample was purified by sublimation under vacuum; the original sample was equilibrated with a great excess of water; the sample previously treated with water was equilibrated with a great excess of heavy water. It was observed that the intramolecular isotope effect, which is near 2.8 per cent, is increased by 0.17 ± 0.28 per cent upon perdeuteration. Theoretical calculations for a simple two-fragment model and for simple bond rupture in a three-fragment model indicate perdeuteration would increase the intramolecular isotope effect. Molecular vibrational analysis for a simple three-center model with asymmetric stretching as the reaction coordinate motion indicates perdeuteration increases the intramolecular carbon isotope effect. The effect of isotope fractionation attending ionization of the monoanion of malonic acid on the intermolecular isotope effect, k_1/k_3, in the decarboxylation of the monoanion in water at 100.0°C, was studied. The ratios of $^{13}C/^{12}C$ in the carbon dioxide produced by less than three per cent decarboxylation in water solutions of seven different dianion-monoanion ratios were determined. The experimental value of the equilibrium constant K_x was found to be 1.0185 ± 0.0055, if solvation is neglected. Sixteen types (sites) of solvation are considered theoretically. Preliminary theoretical calculations of molecular vibrations indicate the equilibrium constant for isotope fractionation in the ionization of acetic acid is 0.9943, slightly less than unity. The equilibrium constant K_{ion} should equal K_x if changes in structure other than the carboxyl group have no effect on the ionization process. (A.G.W.)

35579 THE OXIDATION STATES OF Cl^{36} IN NEUTRON-IRRADIATED MINERALS AND THE EXCHANGE OF S^{35} BETWEEN ELEMENTAL SULFUR AND SULFUR MONOCHLORIDE. Charles Wesley Owens. Thesis, Lawrence, Kan., Univ. of Kansas, 1963. 202p.

The discovery that cosmic-ray-produced secondary neutrons form ^{36}Cl in barely detectable amounts in some terrestrial minerals prompted an investigation into the possibilities of natural Szilard-Chalmers enrichment of the specific activity of ^{36}Cl. Ten chlorine-containing minerals were irradiated in the Brookhaven and Argonne CP-5 reactors. The samples were allowed to decay for several months after the irradiation, then dissolved and mixed with chloride, chlorate, and perchlorate carriers. The three oxidation states were separated by chemical methods. Each fraction was purified and counted as AgCl. In only two minerals was any ^{36}Cl activity found in a state other than chloride. The occurrence of nearly all the ^{36}Cl activity as chloride indicates that no useful Szilard-Chalmers enrichment of the ^{36}Cl activity in natural minerals can be expected. For a study of the exchange of ^{35}S between elemental sulfur and sulfur monochloride solutions were prepared of purified sulfur monochloride and ^{35}S-labelled sulfur in ethylene dibromide. The exchanges were carried out in heavy-wall Pyrex tubes, primarily at 103.5°C. At the desired time, the exchange was quenched by dipping the tubes in liquid nitrogen. The sulfur monochloride was separated from the sulfur by vacuum distillation and oxidized to sulfate by concentrated nitric acid. The course of the exchange was followed by measuring the radioactivity of samples of $BaSO_4$ prepared from the oxidized distillate. A general reaction mechanism consistent with the observed behavior is proposed. A simple exchange involving a transition-state complex may occur, (1). In addition it is proposed that a small amount of catalytic species C is produced slowly by heat (or rapidly by UV light) from S_2Cl_2, (2). The catalyst then reacts with S_8 in the rate-determining step, (3), forming a reactive complex which rapidly attacks the S_2Cl_2, (4). The actual transfer of the sulfur atoms occurs upon break-down of the complex formed in step (4). As the concentration of catalyst slowly increases the rate of the exchange increases. When the equilibrium of step (2) is established the exchange occurs at its limiting rate. (Dissertation Abstr., 24: No. 12, Pt. I (June 1964))

35580 THE DETERMINATION OF INTERMOLECULAR POTENTIAL PARAMETERS FROM SCATTERING DATA. William Albert Sanders. Thesis, Lafayette, Ind., Purdue Univ., 1963. 173p.

An investigation of the problem of determining the parameters of intermolecular potential functions from the results of molecular beam scattering experiments consists of two parts. The first part is the determination of a set of asymptotic phase shifts that will reproduce the observed scattering cross sections. Several preliminary calculations were made, and the results indicated strongly that there is a unique relationship between the phase shifts and the scattering data. Most of the effort was directed toward the determination of the parameters of the intermolecular potential function from a given set of phase shifts. The analysis was based on the calculation of phase shifts by the WKB method. The simplest potential function studied was the square well model. In this case the expression for the phase shifts could be evaluated analytically. The potential parameters could be determined very easily by solving a set of three simultaneous transcendental equations with a high-speed computer. An iterative method was developed for determining the parameters of the Lennard-Jones potential function. An inversion program was developed for the Sutherland potential. In order to obtain increased flexibility in the shape of the intermolecular potential, additional work was done with a function having five adjustable parameters. The outer portion of this potential function could be determined by the method used for the Lennard-Jones potential, but the remaining parameters could not be isolated individually. An approximate method was developed for the simultaneous iterative determination of the four inner parameters and a computational program was written for the IBM 7090 computer. Computing time was cut down to less than fifteen seconds per cycle, and the results were felt to be good enough to justify further development of the method. (Dissertation Abstr., 24: No. 12, Pt. I (June 1964))

35581 A STUDY OF THE THIRD ORDER DISPROPORTIONATION OF DIVALENT RARE EARTHS IN MOLTEN KCl–LiCl: USE OF CHRONOPOTENTIOMETRY AND CHEMICAL RATES. George Melvin Campbell. Thesis, Nashville, Vanderbilt Univ., 1963. 131p.

Electrochemical techniques used to examine the chemistry of some rare earth metals capable of existing in the oxidation states of two and three in LiCl–KCl molten eutectic included chronopotentiometry supplemented by voltammetry, controlled potential coulometry and the monitoring of equilibrium potentials. It was found that the rare earth species Eu(II), Yb(II), and Sm(II) are unstable in LiCl–KCl eutectic at 450°. The relative stability of these species decreases in the order listed with Eu(II) being considerably more stable than Sm(II). When the trivalent chlorides were reduced exhaustively at a controlled potential and subsequently reoxidized, there was a noticeable decrease in the concentration of the oxidized form. An insoluble black material suggestive of the rare earth

in its metallic form was always present after continued reduction at a controlled potential. On the basis of these observations a third order disproportionation reaction was postulated. Relationships based upon steady state theory which could be applied to chronopotentiometric data were developed for the third order reaction. It was possible in this way to estimate the forward rate constant for the disproportionation of Yb(II). By monitoring the equilibrium potential of the rare earth (III, II) couple it was possible to follow the concentration as a function of time for ytterbium and europium. A brief study was made of the molten $LiNO_3$–KNO_3 eutectic system and of fused potassium thiocyanate. The nitrate melts were complicated by the reduction of the nitrate ion before any rare earths such as La(III) reduced. However, voltammetric waves were found for Yb(III). Molten thiocyanate offers promise as a solvent for future study as evidenced by the fact that a black deposit of lanthanum could be obtained by controlled potential electrolysis at −1.2 volts versus a Ag/AgSCN reference electrode. (Dissertation Abstr., 24: No. 12, Pt. I (June 1964))

35582 METHOD FOR THE PREPARATION OF ZIRCONIUM TETRACHLORIDE. Gordon Andrew Carlson (to Pittsburgh Plate Glass Co.). German Patent 1,169,430. May 6, 1964. Priority date Mar. 11, 1959, United States.

Zirconium tetrachloride is prepared by the chlorination of mixtures of zirconium dioxide and carbon at elevated temperatures in a vortex layer of the solid particles of these substances, which are fluidized by the rising chlorine gas. The porous solid particles used are sifted through a sieve of 4900 meshes/cm^2 so that they have a size of about 0.15 to 1.2 mm and a bulk density of about 0.4 to 1.2 g/cm^3. (Gmelin Inst.)

35583 METHOD FOR THE PREPARATION OF FLUORIDES OF NOBLE EARTHS AND/OR THORIUM. Ekkehard Greinacher (to Th. Goldschmidt AG). German Patent 1,169,907. May 14, 1964. Filed Oct. 9, 1962.

Compounds of rare earths and/or thorium are reacted with hydrofluoric acid or its salt in a basic watery phase. The reaction is carried out directly in a basic watery suspension either with hydrofluoric acid or with fluorides that are more easily soluble than the fluorines of the rare earths and/or thorium by adding an acid. The dissolved contaminates are finally separated in a known manner. The reaction is preferably carried out at a temperature between 60 and 100°C and at a pH value of less than 4. (Gmelin Inst.)

Organic Chemistry

Refer also to abstract 35934.

35584 SYNTHESIS, POLYMERIZATION AND COPOLYMERIZATION OF VINYL THIOACETATE. Gy. Hardy, J. Varga, K. Nyitrai, I. Czajlik, and L. Zubonyai (Scientific Research Inst. of the Plastic Industry, Budapest and Budapest Polytechnical Inst.). Vysokomolekul. Soedin., 6: 758-65(1964).

Macromolecules similar to the mercaptoamino compounds were synthesized. Since the corresponding monomers (vinylamine, vinylmercaptan) are chemically unstable, polymers containing free amino and mercapto groups could be synthesized only circuitously. It proved possible to convert copolymers of vinyl thioacetate and N-vinyl compounds. A study was made of the conditions for the synthesis of vinyl thioacetate, its homopolymerization and copolymerization, and the possibility of chemically converting the resultant polymers. Certain N-vinyl compounds such as N-vinylphthalimide and N-vinylcarbazole were used as comonomers in copolymerization. A study was made of the conditions for synthesizing copolymers containing free mercapto and amino groups from vinyl thioacetate–N-vinylsuccinimide and vinyl thioacetate–N-vinylphthalimide. The 2-acetoxyethyl thioacetate was observed to have a retarding effect on the polymerization process. It was concluded that substitution of a sulfur atom for oxygen increases monomer reactivity and the electronegativity of the resultant radical. This follows from sulfur's strong nature as an electron donor. When copolymers (vinyl thioacetate–vinylsuccinimide and vinyl thioacetate–vinylphthalimide) were treated with hydrazine hydrate, polymers were obtained containing free -Sh and NH_2-groups, which rapidly oxidize in the air. (TCO)

35585 THEORY OF THE KINETIC SOLVENT-ISOTOPE EFFECT IN ACID-CATALYZED ORGANIC REACTIONS. [PART] II. Alfred V. Willi (Universität, Bern). Z. Naturforsch., 19b: 461-7(June 1964). (In German)

From the known difference of free energies of liquid H_2O and D_2O at 25°C, the following partition function ratio may be calculated: $Q_{D_2O}/Q_{H_2O} = 1416$. By combination with the constant $L = 11.0$ for the equilibrium $2\ D_3O^{\oplus} + 3\ H_2O \rightleftharpoons 2\ H_3O^{\oplus} + 3\ D_2O$, $Q_{D_2O}/Q_{H_2O} = 16100$ is obtained. The partition function ratio of an organic acid ROH is approximated by $Q_{ROD}/Q_{ROH} \approx (Q_{D_2O}/Q_{H_2O})^{1/2}$. $K_H/K_D \approx 3.3$ is calculated for the solvent isotope effect on the acidity of ROH. Correspondingly, the approximation $Q_{SD}/Q_{SH} \approx (Q_{D_2O}/Q_{H_2O})^{1/2}$ is introduced for conjugate acids ($SH^{\oplus}$) of ethers and carbonyl compounds, leading to the solvent isotope effect: $K_H/K_D \approx 2.2$. In the acid-catalyzed hydrolysis of acetals, the formation of the transition state involves the complete transformation from the $H_3O^{\oplus}$ to the H_2O state of 2 OH bonds and the partial transformation of one more OH bond. Consequently, the limits $1/3.3 < k_H/k_D < 1/2.2$ are calculated for the kinetic solvent isotope effect. The following equation is valid for the general acid catalysis by HA of the enolization of acetone: $k_{HA}/k_{DA} = (K_{HA}/K_{DA})/(K_{SH}/K_{SD})$. Theoretical values are calculated to agree well with experimental data. On the basis of a simple model for the transition state, the solvent isotope effect on rate determining $H^{\oplus}$ transfer from acetic acid to a substrate (general acid catalysis) may be calculated. $(k_{HA}/k_{DA})_{min} = 5.7$ is obtained as a limiting value. (auth)

Radiation Chemistry and Radiochemistry

Refer also to abstracts 35265, 35894, 36053, and 36148.

35586 (AERE-R-4198) RADIOLYSIS OF CARBON MONOXIDE AND OF CO/CO_2 MIXTURES. W. R. Marsh and J. Wright (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). May 1964. 42p.

The radiolysis of CO and of CO/CO_2 mixtures was studied at a temperature of 130–150°C in the DIDO Reactor. Starting with pure CO, the only reaction products found were CO_2 and solid which, at this temperature, has the approximate formula $C_{1.9}O$. The kinetics of CO disappearance can be interpreted by a scheme whereby CO is destroyed with a G(−CO) of about 5 and a simultaneous reaction takes place between CO_2 and the solid to reform CO. The effect of adding other gases, CO_2, O_2, and N_2 on the radiolysis of pure CO was also studied and effects of the presence of some metallic surfaces on the distribution of solids were sought. (auth)

35587 (BNL-8246) Co^{60} GAMMA-RADIATION-INDUCED POLYMERIZATION OF ETHYLENE. [PART] II. L. E. Kukacka, P. Colombo, J. Fontana, R. N. Chapman, and M. Steinberg (Brookhaven National Lab., Upton, N. Y.). July 1964. Contract AT-30-2-GEN-16. 10p.

Preliminary results are given of constant-pressure experiments on the radioinduced homopolymerization of ethylene. The yield was studied as a function of time (dose), and the effects of pressure on the results were determined. The differential polymerization rate was found to vary with the 2.6 power of pressure. The molecular weight of the polymer decreased with radiation intensity but increased with pressure. Pressure had an inverse effect on the density and a direct effect on the melting point of the polymer. (D.L.C.)

35588 (LAMS-3104) THE RADIOCHEMICAL PURIFICATION OF EUROPIUM AND A STUDY OF THE NUCLEAR PROPERTIES OF Eu^{157}, Eu^{158} AND Eu^{159}. W. R. Daniels (Los Alamos Scientific Lab., N. Mex.). Apr. 1964. Contract W-7405-eng-36. 165p.

Chemical procedures have been developed for the rapid preparation of radiochemically pure europium sources from rare earth mixtures and from fission products. Unpurified mixtures of the mono- and di[p(1,1,3,3-tetramethylbutyl)phenyl] esters of orthophosphoric acid are used to extract rare earths in the (III) oxidation state away from europium in the (II) oxidation state. Europium sources can be prepared in about 30 minutes. A slower chemical procedure for the preparation of europium sources which are both radiochemically pure and mass free has also been developed. Di(2-ethylhexyl) orthophosphoric acid is used to separate europium from yttrium, which has a high fission yield and interferes in the subsequent cation column separation, and from many other fission products. Europium is separated from other rare earths by elution from a cation column with ammonium α-hydroxyisobutyrate solution. The radiations of ^{157}Eu, ^{158}Eu, and ^{159}Eu have been studied by beta-ray and gamma-ray scintillation spectrometry. The endpoint energies (and intensities) of the observed major beta groups are 1.34 ± 0.10 Mev (40%), 0.93 ± 0.10 Mev (45%), and 0.71 ± 0.10 Mev (≤15%) for ^{157}Eu; 3.40 ± 0.15 Mev (5%), 2.43 ± 0.10 Mev (44%), 1.55 ± 0.10 Mev (≤36%), and 1.2 ± 0.2 Mev (≤15%) for ^{158}Eu; 2.40 ± 0.10 Mev and ~1.8 Mev? for ^{159}Eu. The energies in Mev (an intensities measured at a distance of 1 centimeter from the detector) of the gamma transitions attributed to ^{157}Eu are 0.064 ± 0.002 (37%), 0.16 to 0.20 (2%), 0.321 ± 0.004 (3%), 0.373 ± 0.005 (14%), 0.411 ± 0.003 (26%), 0.475 ± 0.010 (6%), 0.565 ± 0.010 (2%), 0.621 ± 0.005 (5%), 0.685 ± 0.010 (2%), 0.750 ± 0.010 (1%), and 0.970 ± 0.015 (0.5%). The energies in Mev (and intensities measured at a distance of 5 centimeters from the detector) of the gamma transitions attributed to ^{158}Eu are 0.080 ± 0.002 (91%), 0.182 ± 0.002 (4%), 0.525 ± 0.005 (2%), 0.600 ± 0.005 (6%), 0.750 ± 0.010 (5%), 0.890 ± 0.020 (22%), 0.945 ± 0.010 (56%), 0.995 ± 0.020 (14%), 1.105 ± 0.010 (7%), 1.18 (complex, 13%), 1.26 ± 0.02 (2%), 1.33 (complex, 3%), 1.93 ± 0.02 (4%), 2.16 ± 0.04 (3%), and 2.75 ± 0.05 (1%). The energies in Mev of the gamma transitions attributed to ^{159}Eu are 0.071 ± 0.005, 0.096 ± 0.005, 0.120 ± 0.005, 0.148 ± 0.005, 0.225 ± 0.007, and 0.670 ± 0.010. On the basis of gamma-gamma coincidence measurements, the radiations of ^{157}Eu and of ^{158}Eu have been fitted to partial decay schemes involving the following levels for ^{157}Eu: 0.0545, 0.0640, 0.1158, 0.1315, 0.4366, 0.4772, 0.685, 0.750, and 0.970(?) Mev; and the following levels for ^{158}Eu: 0.080, 0.262, 1.025, 1.185, 1.257, 1.785, 1.93, 2.24, and 2.75(?) Mev. The total beta decay energies are 1.40 ± 0.13 Mev for ^{157}Eu, 3.44 ± 0.20 Mev for ^{158}Eu, and 2.43 ± 0.13 Mev for ^{159}Eu. The half lives of five europium and gadolinium nuclides have been measured by following the beta decay of these nuclides. The half lives are: ^{156}Eu, 15.18 ± 0.10 days; ^{157}Eu, 15.16 ± 0.10 hours; ^{158}Eu, 45.7 ± 0.5 minutes; ^{159}Eu, 17.9 ± 1.0 minutes; ^{159}Gd, 18.56 ± 0.08 hours. An attempt to determine the half life of ^{158}Sm by experiments involving periodic chemical separations of ^{158}Eu from fission product samarium was unsuccessful, but an upper limit of 15 minutes for the half life was established. The fission yields of ^{156}Eu, ^{157}Eu, ^{158}Eu, and ^{159}Eu for thermal neutron fission of ^{235}U and for 25-Mev ^{3}He fission of ^{238}U have been determined. The thermal fission yields are: ^{156}Eu, 0.0125 ± 0.0010%; ^{157}Eu, 0.0060 ± 0.0007%; ^{158}Eu, 0.0031 ± 0.0006%; ^{159}Eu, 0.0011 ± 0.0003%. The 25-Mev ^{3}He fission yields are: ^{156}Eu, 0.27 ± 0.07%; ^{157}Eu, 0.13 ± 0.02%; ^{158}Eu, 0.089 ± 0.015%; ^{159}Eu, 0.057 ± 0.010. The mass assignments for 15.16-hour ^{157}Eu, 45.7-minute ^{158}Eu, and 17.9-minute ^{159}Eu have been confirmed by cross bombardments, radiochemical "milking" experiments, determination of fission yields, and total beta decay energies, and comparison of nuclear levels populated by beta decay with those of the same nucleus populated in other ways. A search has been made for the existence of isomeric states of ^{156}Eu, ^{158}Eu, and ^{160}Eu. Beta decay and gamma scintillation spectra observations on fission product europium and on europium produced by 14-Mev deuteron bombardment of ^{158}Gd, 22-Mev bremsstrahlung irradiation of ^{160}Gd, and 14-Mev neutron bombardment of ^{158}Gd, ^{160}Gd, and ^{159}Tb reveal no definite evidence for the existence of isomeric states with half lives in the range 4 minutes to 70 days for ^{156}Eu, 15 minutes to 15 days for ^{158}Eu, and 5 minutes to 18 hours for ^{160}Eu. (auth)

35589 (NASA-TN-D-2452) THE X-IRRADIATION OF HYDRAZINE AND 1,1-DIMETHYLHYDRAZINE. Harold Lucien and Murray L. Pinns (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). Aug. 1964. 10p.

Hydrazine and 1,1-dimethylhydrazine were radiolyzed at room temperature by using about 1 gram of liquid or ½ to 2 liters of vapor at room-temperature vapor pressure. A tungsten-target x-ray source operating at 300 kilovolts and 6 to 8 milliamperes (0.1 to 1.0 A) was used at intensities of 1×10^2 to 1×10^3 R per minute to give total doses of 4.1 to 2.3×10^6 Rads. The amounts of decomposition were dependent on total dose and independent of dose rate. In the case of hydrazine vapor, the decomposition was also directly related to surface area. There was a lesser surface effect with liquid hydrazine, but this variable was not studied for 1,1-dimethylhydrazine. The order of decreasing sensitivity to x radiation is: hydrazine vapor, 1,1-dimethylhydrazine vapor, 1,1-dimethylhydrazine liquid, and hydrazine liquid. The decomposition products of hydrazine were nitrogen, hydrogen, ammonia, and unidentified products. The same products plus methylamine, dimethylamine, and hydrazine were found from the decomposition of 1,1-dimethylhydrazine. In addition, the 1,1-dimethylhydrazine underwent postirradiation changes. Values for G (number of molecules of sample decomposed per 100 ev of absorbed energy) of the order of 10^6 suggest that the vapor-phase decompositions are chain reactions. (auth)

35590 (NP-14182) POLUCHENIE RADIOAKTIVNOGO ZHELEA-59 BEZ NOSITELYA. (Preparation of Radioactive Carrier-Free Iron-59). I. Geletseanu, G. Fodor, K. Kiotan, and M. Kristu (Academia R. P. R. Institutul de Fizica Atomica, Bucharest). [1961]. 15p.

Preparation of carrier-free ^{59}Fe by irradiation of metallic cobalt and cobalt chloride by fast neutrons in the VVR-C reactor is described. An 80% extraction of radioactive iron from a mixture containing Co^{60} and other im-

purities was carried out by acetylacetone at pH 3 to 4. Complete extraction was achieved after 3 or 4 steps. A small amount of Co was extracted with iron by TBP. Satisfactory extraction of radioactive iron from 6 and 8 M HCl was achieved using ethyl and isopropyl ethers. However, an anion exchange method had to be used in order to obtain chemically pure ^{59}Fe. (R.V.J.)

35591 (RCC-R-175) THE ABSOLUTE STANDARDIZATION OF ZIRCONIUM-95. G. D. M. Parker (United Kingdom Atomic Energy Authority. Research Group. Radiochemical Centre, Amersham, Bucks, England). June 1964. 33p.

A method for the absolute standardization of zirconium-95 in solution is described, using 4π beta-gamma coincidence counting. The basis of the method is to carry out repetitive standardizations on counting sources prepared from the solution of (zirconium-95 + niobium-95), and fit the results arithmetically to a theoretical growth and decay curve, to obtain the radioactive concentration of both zirconium-95 and niobium-95 in the solution. The theory of growth and decay of radioactive parent, daughter, and grand-daughter nuclides is studied in relation to zirconium-95 and its daughter niobium-95 isomers. Equations are derived, with which the ratio of niobium-95 to zirconium-95 may be calculated, if the activity of (zirconium-95 + niobium-95) is known at different instances in time. A new method is shown, of deriving a theoretical correction for complex decay schemes, which may be applied to the basic coincidence equation to give the disintegration rate of (zirconium-95 + niobium-95) in the counting sources, without previous accurate knowledge of the state of growth of niobium-95. An actual experiment is described, and the results of the standardization are given, together with a critical survey of the errors involved. Equations are derived for evaluating the magnitude of the theoretical errors in the results. Independent checks were made, on the results of the primary standardization, by coincidence counting zirconium-95 after chemical separation from its daughter niobium-95 isomers, and by repeated measurements of a sealed ampoule of the (zirconium-95 + niobium-95) solution, in a high stability 4π gamma ion chamber. (auth)

35592 (TID-20948) THE INFRARED SPECTRA OF POLYBUTENE-1 BEFORE AND AFTER GAMMA IRRADIATION (thesis). Paul Edward Tippens (Georgia. Univ., Athens). 1963. Contract [AT(40-1)-2418]. 47p.

The infrared spectra of polybutene-1 films were measured and vibrational assignments made for the observed bands. It was found that polybutene-1 may have only two crystalline forms instead of three; the third form reported by Zannetti et al. appears to be a mixture of the first two forms. Irradiation of polybutene-1 samples at doses of 0.77 to 3.2×10^9 rads revealed new bands at 727, 835, 869, 889, 909, 935, 967, 997, 1605, 1643, 1654, and 1715 cm^{-1}. Trans-vinylene vinyl, and vinylidene unsaturation bands were formed, and their growth and decay with increasing irradiation dose were studied. Apparently all the crystallites in polybutene-1 were melted by irradiation. Measurements at 135 and 150°C showed that the trans-vinylene, vinyl, and vinylidene bands decreased with temperature, but a rapid growth of the carbonyl band makes it difficult to distinguish between temperature and oxidation effects. (D.L.C.)

35593 (UJV-1075/64) LOCALIZATION OF ENERGY IN THE RADIOLYSIS OF SOLUTIONS. PART V. DEGRADATION SPECTRUM OF ELECTRONS, ELECTRONIC EXCITATION SPECTRA OF MOLECULES, AND THE PRIMARY RADIATION CHEMICAL YIELD. Z. Prášil, K. Vacek, and J. Bednář (Československá Akademie Věd. Ústav Jaderného Výzkumu, Řež). [1964]. 23p.

Using the optical approximation, expressions were derived for primary radiation chemical yield of decomposition of pure compounds or their mixtures, and for probabilities of energy localization of different components of a mixture. The limited validity of this approximation is discussed, and some consequences of this for the radiolysis of mixtures are shown. It was concluded that in mixtures the existence of degradation spectrum of electrons itself can produce some differentiation of the total yield of a product (or of its part) to several parts, hitherto explained exclusively by relevant number of different reaction mechanisms, though the real mechanism may be only a single one. (P.C.H.)

35594 THE EFFECT OF SLOW ELECTRONS ON THE PROTEOLYTIC ACTIVITY OF TRYPSIN FOR THICK LAYERS. E. Bender and H. Pupke (Deutsche Akademie der Wissenschaften, Berlin). Arch. Geschwulstforsch., 22: 193-9(1963).

In thick layers, 12.7 μg/sq cm and 127 μg/sq cm, the enzyme trypsin was irradiated with electrons of an energy of 1,000 ev. The assay of the trypsin activity after irradiation was carried out by incubation for 2 hr of the enzyme with casein in a phosphate buffer. The calculation of the dose effect curves was done by a mathematical process reported previously. The range was estimated to be 370 Å. From the calculated inactivation volume the conclusion is drawn that the loosening of a hydrogen bridge bond is necessary for the inactivation of the molecule. (Excerpta Med., Sect. 23, 1: No. 7, July 1964)

35595 RADIOCHEMICAL EFFECTS OF FAST ELECTRONS ON URANIUM FLUORIDES. A. I. Migachev and A. P. Senchenkov. At. Energ. (USSR), 16: 510-14(June 1964). (In Russian)

The effect of fast electrons on UF_6, UF_5, and UF_4 was investigated. The radiochemical yield in the disintegration of UF_6 is equal to 1.1 10^{-2} molecules per 100 ev. The dynamic formula $UF_6 \rightleftharpoons UF_5 + \frac{1}{2}F_2$ is set up after protracted irradiation of UF_6 in the system. The rate of radiation fluorination of UF_5 and UF_4 is proportional to the fluorine pressure and the square root of the radiation intensity. (tr-auth)

35596 RADIOLYSIS OF SOLID GLYCINE. Gisuke Meshitsuka, Kotaro Shindo, Atsuko Minegishi, Hiroshi Suguro, and Yoshiharu Shinozaki (Tokyo Metropolitan Isotope Center). Bull. Chem. Soc. Japan, 37: 928-30(July 1964).

Solid glycine was radiolyzed by ^{60}Co γ rays in vacuo at room temperature, and all the products except H_2 were measured after dissolving the irradiated samples in water. The hydrogen was collected and measured directly from the irradiated solid samples. All products except H_2 increase linearly with the dose, while H_2 shows a plateau from a relatively low dose. The yields of products are as follows: $G(H_2) \sim 0.2$, $G(NH_3) = 4.8$, $G(CH_2NH_2) = 0.2$, $G(CHOCO_2H) = 2.5$, $G(CH_3CO_2H) = 2.3$, $G(CO_2) \sim 0.2$, and $G(HCHO) \sim 0.03$. The mechanisms of the primary process and the reactions to give final products were proposed with reference to the results of the ESR studies. (auth)

35597 THE RADIATION ANNEALING OF PHOSPHORUS-32 WITH COBALT-60 GAMMA-RAYS FOR SEVERAL NEUTRON-IRRADIATED INORGANIC PHOSPHORUS COMPOUNDS. Kichizo Tanaka (Japan Atomic Energy Research Inst., Tokyo). Bull. Chem. Soc. Japan, 37: 1032-8(July 1964).

Radiation annealings with cobalt-60 gamma rays were investigated for several neutron-irradiated inorganic phosphorus compounds. The reduced species in sodium and potassium orthophosphate salts and in sodium pyrophosphate salt decreased upon gamma irradiation, and in increase in the retention was observed. However, the polyphosphate increased initially in the several orthophosphate salts. Three processes were observed, the rate constants for these processes were estimated, and two other processes are suggested. The main process is the oxidation of the reduced species to phosphorus(V) species. Radiation annealing was studied for phosphates as a function of the dose rate, the total dose of irradiation, and the temperature during gamma irradiation. It was found that annealings are dependent upon the total dose and the temperature during irradiation and are independent of the dose rate. In orthophosphates and pyrophosphate, chemical species other than the parent species were easily annealed by gamma irradiation, whereas no detectable annealing was observed in sodium orthophosphite or sodium hypophosphite. Annealing was affected by the hydrogen content of the salts. (auth)

35598 ELECTRON PARAMAGNETIC RESONANCE SPECTRA OF PHOSPHATE GLASSES IRRADIATED WITH GAMMA-RAYS. Yasuo Nakai (Tokyo Shibaura Electric Co., Ltd.). Bull. Chem. Soc. Japan, 37: 1089-90(July 1964).

Phosphate glass samples with the composition of (RPO_3) [R = Li, Na, Ca, Ba], where R/P = 1, were irradiated at room temperature with ^{60}Co gamma rays ($5 \sim 6 \times 10^6$ R). Three distinct types of defect centers were found. The irradiated lithium phosphate glasses ($LiPO_3$) exhibited the ESR spectra of two strong lines (P_1 and P_2) and of the other two weak absorption lines. The shapes of the weak resonance lines were dependent on the kinds of alkali or alkaline earth ions. In the case of a sodium or potassium modifier, the spectra disappear on both the low and the high magnetic field sides. (P.C.H.)

35599 THE RADIOLYSIS OF POLYAMIDES. V. A. Sharpatyi, G. L. Aptekar, N. V. Zakatova, and A. N. Pravednikov (Karpov Inst. of Physics and Chemistry, [Academy of Sciences,] USSR). Dokl. Akad. Nauk SSSR, 156: 626-9 (May 21, 1964). (In Russian)

In order to obtain information on the primary stages of radiolysis in polyamides, irradiations were carried out on the polyamides $-CONH(CH_2)_nCONH(CH_2)_m$ and $-CONH(CH_2)_nNHCO(CH_2)_mCONH-$ (where n and m can vary from 4 to 10) and on their polyamide analogs having a low molecular weight. The $G(H_2)$ yield does not change up to a dose of 400 Mrad (Mrad = million rads), while the G(CO) yield decreases with increasing dose on irradiating polycaprolactam fiber. The composition of the gas varies on irradiating the enanthic polymer (n = 6), the pelargonic polymer (n = 8), and undecane (n = 10). The $G(H_2)$ yield tends to increase with increasing number of methylene groups in the molecule. On irradiating at +100°C, the yield of gas decreases sharply, and the G(CO) yield rises somewhat compared to the $G(H_2)$ yield. ESR spectra show that the initial radical yield is independent of temperature (−196 to +20°C) and type of sample (resin or fiber). The radical results as a result of rupture of a C−H bond. On irradiating with 1.7 mev electrons at −180 to −160°C, the concentration of radicals is a linear function of dose, and the G yield of radicals increases from 1.5 to 2.0 on increasing n from 5 to 10. A mass-spectrometric analysis of the radiolysis products of butyramide of butyric acid shows the presence of H_2, CO, $CH_3CH_2CH_3$, and $CH_3CH:CH_2$. However, the $G(H_2)$ yield depends on the dose and temperature. Hence, it was concluded that the formation of H_2 and CO are independent of each other in the irradiation of the polyamides and in the irradiation of the analogs with a low molecular weight. (TTT)

35600 ELECTRON SPIN RESONANCE SPECTRA OF RADICALS OBTAINED FROM THE GAMMA IRRADIATION OF POLYAMIDES. A. I. Brodskii, A. S. Fomenko, T. M. Abramova, E. G. Furman, E. P. Dar'eva, I. I. Kukhtenko, and A. A. Galina (Pisarzhevskii Inst. of Physical Chemistry, Academy of Sciences, Ukrainian SSR). Dokl. Akad. Nauk SSSR, 156: 1147-9(June 11, 1964). (In Russian)

ESR spectra were obtained on samples of poly-ϵ-caproamide irradiated in vacuum, which were not deuterated $HO[-CO-CH_2-(CH_2)_4-NH]_nH$ (sample I), and which contained deuterium at various positions in the chain: $[-CO-CD_2-(CH_2)_4-NH]$ (sample II), $[-CO-CD_2-(CH_2)_3-CD_2-NH-]$ (sample III), and $[CO-(CH_2)_5-ND]$ (sample IV). The method of sample preparation is given. Infrared spectrum analysis was used to control the sample purity. Thus, the complete removal of deuterium from the ND group of the polymer was accompanied by the disappearance of the ND valence oscillation in the region of 2500 cm^{-1}. Deuterium in the α-methylene position can also be identified by infrared spectrum analysis. Sample III with deuterium in two CH_2 groups next to the carbonyl and NH groups gave a completely resolved triplet 1:2:1 with a splitting $\alpha_\beta = 28$ oerst and a total width of 56 oerst between the maxima on the ends. The ESR spectrum corresponds to the radical $-CD_2-CO-NH-C^*D-CH_2-$. On heating sample III from 30 to 100°C, the intensity of the signal decreases, but the shape, total width, splitting and relative intensities remain the same. Thus, the ESR spectrum does not represent two or more radicals. The ESR spectra of irradiated polyamides containing 8 to 10 CH_2 groups in the chain indicate the presence of a radical, in which a hydrogen atom from a CH_2 group in the α-position to NH was removed. (TTT)

35601 THE MECHANISM OF THE RADIATION POLYMERIZATION OF ETHYLENE. G. N. Gerasimov, P. M. Khomikovskii, and A. D. Abkin (Karpov Inst. of Physics and Chemistry, [Academy of Sciences,] USSR). Dokl. Akad. Nauk SSSR, 156: 1150-3(June 11, 1964). (In Russian)

The kinetics of the radiation polymerization of ethylene was investigated by means of a specially constructed dilatometer, in which the reaction rate was measured under strictly constant pressure. The polymerization was carried out by irradiating ethylene at 100 to 250 atm at a temperature of 25 to 55°C with ^{60}Co γ rays at a dose rate of 9 rads/sec. A rate maximum W_{max} was observed that decreased to a lower conversion rate at a higher temperature and constant pressure. The decrease in W_{max} was not due to formation of an inhibitor, and cannot be explained by the presence of long-lived radicals. An ESR spectrum on polyethylene irradiated in a vacuum at −196°C showed a seven-component spectrum characteristic of the allyl radical. Thus, it is believed that radicals from the gas phase react rapidly with radicals in the solid polymer, which is first formed as a highly dispersed charged aerosol. With further irradiation the state of dispersion decreases, and the reaction rate falls off. The reaction rate can be represented by the equation: $W = W_0 + (W_{sol}^{0.5} K_p C_{ethyl} / K_{tot}^{0.5}) P$. Here W_0 is the initial reaction rate, and W_{sol} is the rate of radical formation in the polymer under irradiation. C_{ethyl} is the concentration of ethylene dissolved in the polymer, and P is the amount of polymer per unit volume of the reacting vessel. The value of $K_p/K_{tot}^{0.5}$ is calculated 5.6 $l^{0.5} \times sec^{-0.5} \times mol^{-0.5}$, which is higher than the literature

values. At low doses W_0 can be neglected and it was found that $K = \ln P/t$, where t is the time of polymerization. The experimental results are in good agreement with this relationship. (TTT)

35602 EFFECTS OF IONIZING RADIATION ON POLYSACCHARIDES. V. S. Minina, Kh. U. Usmanov, M. S. Ishmukhamedova, and A. T. Lubenets. Fiz. i Khim. Prirodn. i Sintetich. Polimerov, Akad. Nauk Uz. SSR, Inst. Khim. Polimerov, No. 1, 53-60(1962). (In Russian)

The radiation-induced change in the chemical composition of various pentosan-containing materials was studied. Considerable destruction of the polysaccharide occurred, as a result of which mono- and oligosaccharides and dextrin-like substances were formed. The amount of water-soluble substances in some of the materials was up to 50% of the dry weight, and the yield of monose, up to 13% (for a radiation dose of 300 Mr.) Hemicelluloses differed from celluloses in their stability to gamma irradiation. Mild hydrolysis gave monoses in yields up to 60% compared with 30% from nonirradiated materials. (tr-auth)

35603 EFFECTS OF γ RADIATION ON THE POLYMERIZATION OF ACRYLONITRILE IN SOLUTIONS. A. Arifdzhanov, S. V. Starodubtsev, and A. S. Sultanova. Fiz. i Khim. Prirodn. i Sintetich. Polimerov, Akad. Nauk Uz. SSR, Inst. Khim. Polimerov, No. 1, 143-8(1962). (In Russian)

Under the influence of gamma radiation in concentrated sodium, ammonia, and potassium thiocyanate solutions, acrylonitrile may be polymerized. Because of limited solubility the polymerizates cannot be used for spinning solutions. Acrylonitrile polymerization is complete in dimethylformamide at γ doses of 4 Mr. Although the initial solution concentration is 30%, because of the specific viscosity from the low molecular weight and branching of the macromolecule chains, these also cannot be used as spinning solutions. In a dimethylformamide–water system acrylonitrile is polymerized, as well as in the absence of water, the water having almost no effect on the viscosity. (tr-auth)

35604 RADIATION BINDING OF ACRYLONITRILE TO POLYVINYL ALCOHOL. Kh. U. Usmanov, R. S. Tillaev, U. N. Musaev, and Sh. A. Kurbanov. Fiz. i Khim. Prirodn. i Sintetich, Polimerov, Akad. Nauk Uz. SSR, Inst. Khim. Polimerov, No. 1, 207-14(1962). (In Russian)

The γ radiation from ^{60}Co may be used to produce grafted copolymers of alcohol with acrylonitrile. The yield depends on the radiation dose and the amount of water added. The formation of the grafted copolymers may be shown by the solubility and thermal properties of the product. The plasticizer glycerine decreases the gloss transition temperature of the copolymers, but the grafted copolymers of polyvinyl alcohol with acrylonitrile are organically compatible with glycerine. By saponification of the polyacrylonitrile component, the product is converted to a polyelectrolyte, which swells considerably in water and has the properties of a weak polymer acid. (tr-auth)

35605 ALTERATION OF POTATO STARCH GRANULES UNDER THE INFLUENCE OF Co^{60} RADIATION. G. M. Maslova and I. N. Putilova (Technological Inst. of the Food Industry, Moscow). Izv. Vysshikh Uchebn. Zavedenii, Pishchevaya Tekhnol., No. 3, 28-35(1963). (In Russian)

Irradiation of potato starch with ^{60}Co γ doses of 50×10^6 R at 2000 R/min decreased the temperatures of initial and final gelation. The radiation did not affect its distribution but increased its heterogeneity and fragility and reduced its elasticity. Microphotometric studies of starch granules indicated weak points distributed along radial and concentric lines. The destruction lines, forming a splitting angle in the granules, are a result of internal structure rather than the effect of radiation. The most common angle of splitting was at 120°. (R.V.J.)

35606 THE PHOTOCHEMICAL REDUCTION OF RARE EARTH IONS IN FUSED HALIDES. H. L. Pinch (RCA Labs., Princeton, N. J.). J. Am. Chem. Soc., 86: 3167-8(Aug. 5, 1964).

Irradiations of molten halides containing rare earths, which would eliminate most of the inherent difficulties associated with the solid-state irradiations, were carried out. Molten solutions of dried and brominated $BaBr_2$ with 0.2 mole % Tm^{3+} were irradiated with γ rays, the output of a low pressure mercury lamp, or with a low pressure hydrogen discharge produced within the quartz reaction tube itself. The oxidized anionic species were swept out or trapped out of the reaction tube. Upon cooling the molten bromides, each of the three radiation treatments showed significant quantities of divalent Tm. The intensity of the Tm^{2+} fluorescence obtained from the low pressure hydrogen discharge material indicates a level of reduction much greater than that possible through reduction by solid-state irradiation. (P.C.H.)

35607 PULSE RADIOLYTIC DETERMINATION OF pK FOR HYDROXYL IONIC DISSOCIATION IN WATER. Joseph Rabani and Max S. Matheson (Argonne National Lab., Ill.). J. Am. Chem. Soc., 86: 3175-6(Aug. 5, 1964).

Pulse radiolysis was used to study the rate of ferrocyanide oxidation as a function of pH and thereby obtain a precise value of the pK at 23°C. Ferrocyanide was usually present in such excess that a pseudo-first-order oxidation resulted. The results showed that changes in k with pH were due to the OH^- concentration and not to added Ba^{2+}, Na^+, or N_2O. Finally, when low concentrations of $Fe(CN)_6^{4-}$ and high pulse intensities ($\sim 1.3 \times 10^{-5}$ M OH) were used in N_2O solutions, the radical-radical reactions competed with the reaction $OH + Fe(CN)_6^{4-} \rightarrow OH^- + Fe(CN)_6^{3-}$, and this competition determined the final optical density. Computer fitted curves gave $2k_4 = 1.2 \times 10^{10}$ and $2k_7 \sim 2 \times 10^9$ M^{-1} sec^{-1}. The value for $2k_4$ is in satisfactory agreement with previous work. (P.C.H.)

35608 SCAVENGING ACTION IN γ-IRRADIATED AQUEOUS CYSTEINE SOLUTIONS. A. El Samahy, H. L. White, and C. N. Trumbore (Univ. of Delaware, Newark). J. Am. Chem. Soc., 86: 3177-8(Aug. 5, 1964). (TID-20414)

The results of a study on the radiolysis of oxygen-free cysteine solutions are reported. Yields for the disappearance of the cysteine thiol group, G(-RSH), were determined polarographically and were found to be quite sensitive to both pH and $(RSH)_0$. Acetone and nitrate ion were chosen as representative electron scavengers with very high rate constants for the scavenging reaction, 6×10^9 and 1.1×10^{10} 1 $mole^{-1}$ sec^{-1}, respectively. Both scavengers reduced the H_2S yields to low values when present at high concentrations. With added acetone the limiting value of $G(H_2S)$ was about 0.3. Added nitrate reduced the H_2S yield to nearly zero. It was concluded that cysteine is quite effective as an OH and hydrated-electron scavenger. (P.C.H.)

35609 IRREGULARITIES IN THE THERMAL ANNEALING KINETICS OF (n,γ) DAMAGE IN SOME COBALT COMPLEXES. P. N. Dimotakis and A. G. Maddock (Chemical Labs., Cambridge, Eng.). J. Inorg. Nucl. Chem., 26: 1505-8(Sept. 1964).

Annealing isotherms for the neutron-irradiated cobalt complexes $[Coen_2Cl_2]NO_3$ and $[Coen_2Br_2]NO_3$ show certain

irregularities, including even regions in which the retention decreases with increased time of annealing, although no gross thermal decomposition of the solid appears to take place. These irregularities seem to be influenced by the dose of ionizing radiation received by the samples. (auth)

35610 COMMENTARY ON SCAVENGING PLOTS IN RADIATION CHEMICAL STUDIES OF LIQUID CYCLOHEXANE. Cornelius E. Klots, Y. Raef, and Russell H. Johnsen (Florida State Univ., Tallahassee). J. Phys. Chem., 68: 2040-3(Aug. 1964). (TID-20536)

Hydrogen yields from x irradiated liquid cyclohexane in the presence of a variety of potential hydrogen atom scavengers were measured and analyzed within the framework of an assumed scavenging mechanism. Only oxygen- and iodine-containing solutions are amenable to this interpretation, other solutes showing a more complicated concentration dependence. The role of a molecular detachment process is delineated. (auth)

35611 RADIATION CHEMISTRY OF OXALATE SOLUTIONS IN THE PRESENCE OF OXYGEN OVER A WIDE RANGE OF ACIDITIES. Z. D. Draganic, I. G. Draganic, and M. M. Kosanic (Inst. of Nuclear Sciences "Boris Kidrich." Vintcha, Yugoslavia). J. Phys. Chem., 68: 2085-92 (Aug. 1964).

The radiation yields of carbon dioxide, molecular hydrogen, and hydrogen peroxide formed were measured at 50 mM oxalic acid and 0.75 mM oxygen concentrations, over the pH range from 1.61 to 9.85. The results obtained are quantitatively consistent with a simple scheme that allows the determination of the primary free radical and molecular yields in the pH region studied. A cube root dependence of the measured molecular hydrogen yields on oxalic acid concentration was observed. (auth)

35612 SENSITIZATION BY NITROUS OXIDE TO RADIATION-INDUCED CROSS LINKING OF POLYETHYLENE. Yoichi Okada (Sumitomo Bakelite Co., Ltd., Yokohama, Japan). J. Phys. Chem., 68: 2120-5(Aug. 1964).

Gamma irradiation of polyethylene in an atmosphere of nitrous oxide (N_2O) yields a greater degree of cross links and of trans-vinylene unsaturation than does irradiation in vacuo. This sensitization is caused by N_2O molecules dissolved in polyethylene solid. N_2O was consumed at a large G-value, of the order of 10^3, and nitrogen and water were formed. The amounts of nitrogen and water obtained were stoichiometrically equivalent to the loss of N_2O, i.e., $N_2O \xrightarrow{+2H} N_2 + H_2O$. Two hydrogen atoms come from polyethylene. This material balance also shows that the cross links formed due to the sensitization are C–C bonds as in the case of vacuum irradiation. The increments of cross links and unsaturation increase monotonically with increase in N_2O concentration in the solid. The efficiency per N_2O molecule, however, gradually decreases with increase in N_2O concentration. Since the dissolved N_2O forms only about 0.1 wt % in the solid, the absorption of radiation energy by the N_2O is so little that it can be ignored in comparison with the absorption by the polymer. The large G-value for the consumption of N_2O suggests that a part of absorbed energy by the polymer transfers to the N_2O molecule. It is not strange, if such an energy transfer occurs, that a greater number of N_2O molecules is efficiently excited and abstracts two hydrogen atoms from polymer chain segments in a closed vicinity. The abstraction results in the formation of cross links and unsaturation. (auth)

35613 RADIOLYSIS OF SOLID SOLUTIONS OF ACRYLAMIDE AND PROPIONAMIDE. G. Adler (Brookhaven National Lab., Upton, N. Y.), D. Ballantine, R. Ranganthan, and T. Davis. J. Phys. Chem., 68: 2184-9(Aug. 1964). (BNL-7791)

A wide range of solid solutions of acrylamide and propionamide was irradiated to various doses and the gaseous decomposition products measured. G-values for H_2, CO, and CH_4 were determined at several temperatures. The results indicate that either energy transfer reactions or hydrogen atom scavenging are important in determining relative yields. The G-value for CO as a function of composition is unusual and may be influenced by lattice structure. Finally, the hydrogen yield was found to be primarily the result of a bimolecular reaction. (auth)

35614 RADIOLYSIS OF CYCLOHEXANE. V. PURIFIED LIQUID CYCLOHEXANE AND SOLUTIONS OF ADDITIVES. S. K. Ho and G. R. Freeman (Univ. of Alberta, Edmonton, Canada). J. Phys. Chem., 68: 2189-97(Aug. 1964).

The initial product yields (G values) in the γ radiolysis of highly purified liquid cyclohexane were found to be: hydrogen 5.6 ± 0.1; cyclohexene 3.2 ± 0.2; 1-hexene 0.40 ± 0.05; n-hexane 0.08 ± 0.02; methylcyclopentane 0.15 ± 0.01; ethylcyclohexane ~0.04; dicyclohexyl 1.76 ± 0.05; cyclohexylhexene 0.12 ± 0.02; unidentified C_{12} ~0.05. Cyclohexylcyclohexene was a secondary product. Both oxygen and p-benzoquinone reduced the major liquid product yields to the same limiting values: cyclohexene 1.5 ± 0.1; 1-hexene 0.27 ± 0.03; dicyclohexyl 0.29 ± 0.03. From the reduction in the yields of these products, and on the assumption that free radicals were being scavenged by the additives, a lower limit of 1.1 ± 0.3 was obtained for the ratio of the rate constants $k_{disproportionation}/k_{combination}$ for cyclohexyl radicals in liquid cyclohexane. (auth)

35615 THE MEASUREMENT OF MOLECULAR WEIGHT DISTRIBUTION IN POLYMERS BY CROSS LINKING-SOLUBILITY METHODS. William W. Graessley (Univ. of Michigan, Ann Arbor). J. Phys. Chem., 68: 2258-63(Aug. 1964).

The relationship between molecular weight distribution in linear polymers and their subsequent cross linking-solubility behavior was studied, using samples of polystyrene of different average molecular weights and molecular weight distribution. Films of the polymers were cross linked by γ radiation, and gel fraction as a function of radiation dose was determined by solvent extraction. The properties of the solubility curves obtained for each sample were sufficient to provide two independent characterizations of the distribution, $\overline{DP}_w/\overline{DP}_n$ and $\overline{DP}_z/\overline{DP}_w$, as well as two radiation parameters, the radiation dose at gelation in the absence of chain scission, and the chain scission parameter. (auth)

35616 COMPARISON OF THE PHOTO- AND RADIATION-SENSITIZED CIS-TRANS ISOMERIZATIONS OF POLYBUTADIENE. Morton A. Golub (Stanford Research Inst., Menlo Park, Calif.). J. Phys. Chem., 68: 2360-1 (Aug. 1964).

It is shown that thiol radicals have very similar isomerizing efficiencies whether produced by uv or by gamma rays. Data previously obtained are used for the comparison. It is suggested that a value of 750, corresponding to the ratio of rate constants for the isomerization and termination processes, and not one-half of it, should represent the chain length; although two $C_6H_5S\cdot$ radicals are formed in the initiation step, they both take part in isomerization and termination. (P.C.H.)

35617 GENERATION OF ACIDITY IN SILICA GEL BY IONIZING RADIATION. C. Barter and C. D. Wagner (Shell Development Co., Emeryville, Calif.). J. Phys. Chem., 68: 2381-3(Aug. 1964).

The chemical effects of radiation on silica gel were investigated. Detection and measurement of acid sites were made by indicators and by polymerization of isobutylene. It was found that pretreatment of the gel is important in developing activity for polymerization by irradiation. Absorption of organic molecules adsorbed on silica gel were easily obtained with suspensions of the gel in a solvent of suitable refractive index. A parallelism in decay rate of acid centers and those responsible for isobutylene polymerization probably means that the two types of centers are identical. Radioinduced acidity in silica gel may well play an important role in its enhancement of G-value for certain radioinduced polymerizations. (P.C.H.)

35618 GAS CHROMATOGRAPHY OF RADIOISOTOPE LABELED COMPOUNDS. Karel Panek and Karel Mudra. (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Rez). Jaderna Energie, 10: 214-16(June 1964). (In Czech.)

General information on a method combining gas chromatography with tracer techniques is presented. Radioactivity measurement, continuous analysis, GM-counters, proportional counters, scintillation detectors, and ionization chambers are discussed. All information is based on foreign literature. Forty-nine references, including 1 Czech and 1 Russian. (OTS)

35619 PRECISION REMOTE CONTROL PIPETTE FOR WORK WITH RADIOACTIVE SOLUTIONS. S. Gyoergyi and J. Gazsó. Kiserl. Orvostud., 15: 669-70(1963).

This precision remote control pipette possesses the advantages over commercial remote control pipettes that, because of its coarse and fine vertical calibration, it allows sucking up by means of the bulb and the certain and accurate separation of small amounts of the supernatant fluid. One person can easily manage it. Should it become contaminated it is easily decontaminated. (Excerpta Med., Sect. 23, 1: No. 7, July 1964)

35620 ISOTOPE EFFECT IN RADICAL REACTIONS. J. R. Majer, W. D. Capey, and J. C. Robb (Univ. of Birmingham, Eng.). Nature, 203: 294-5(July 18, 1964).

Gas chromatography was used to separate the pairs cyclohexane-perdeuterocyclohexane, benzene-perdeuterobenzene, and toluene-toluene-αd_3. This technique was used to investigate the insertion of methylene into cyclohexane by the photolysis of diketene in the presence of a mixture of cyclohexane and perdeuterocyclohexane. The effect of methyl radicals on the cyclohexane-perdeuterocyclohexane mixture was investigated by the photolysis of acetone in the presence of the mixture. The mixture was also submitted to mercury photosensitization. The isotope effect in the attack of methyl radicals on benzene and perdeuterobenzene was also investigated. (C.E.S.)

35621 EFFECT OF THE β RADIATION OF TRITIUM ON THE LUMINESCENCE AND THE ENERGY TRANSFER PROCESSES IN ANTHRACENE CRYSTALS. Sh. D. Khan-Magometova and G. B. Radzievskii. Opt. Spectr. (USSR) (English Transl.), 16: 457-61(May 1964). Translated from Opt. i Spektroskopiya, 16: 842-50(May 1964).

The decrease of the luminescence of anthracene crystals resulting from irradiation with 10^8–10^9 rad of β electrons from tritium was investigated. The diffusion length of exciton displacement was estimated by extrapolation to zero thickness as $1 \approx 0.13\mu$ from the dependence of luminescence degradation on crystal thickness. It was shown that in crystals 2-6 μ thick energy transfer is effected by reabsorption. (auth)

35622 DEPENDENCE OF THE DURATION OF SCINTILLATIONS IN CsI–Tl AND KI–Tl PHOSPHORS ON THE ACTIVATOR CONCENTRATION. N. N. Vasileva. Opt. Spectr. (USSR) (English Transl.), 16: 462-3(May 1964). Translated from Opt. i Spektroskopiya, 16: 851-3(May 1964).

The duration of scintillations was examined for CsI–Tl and KI–Tl. The activator concentration in the first series of crystals was varied from 0.14×10^{-4} to 15.75×10^{-4} moles Tl/mole CsI, and in the second from 0.70×10^{-4} to 5.45×10^{-4} moles Tl/mole KI. The results show that both the rise time and the decay time of the scintillations are reduced with increasing activator concentration and reach minimum values. Discontinuity was observed in the concentration dependence curves of CsI–Tl only. The absence of a discontinuity in the concentration curve of the scintillation rise time for KI–Tl can be explained on the grounds that the Tl concentrations in the crystals investigated were such that Δt was still too small in comparison to t_0 and could not have been observed in the experiment. In the case of CsI–Tl after the decay time reaches its minimum value a subsequent increase is observed, on the other hand in KI–Tl the scintillation decay time is reduced as the activator concentration is increased. (P.C.H.)

35623 STUDY ON THE RADIOLYSIS OF TRICHLOROETHYLENE. Andrzej Robalewski and Waclaw Zielinski (Inst. for Nuclear Research, Warsaw). Przemysl Chem., 43: 318-20(June 1964). (In Polish)

The formation of oily and solid substances with a high chlorine content and a molecular mass range of 360 to 586 amu in the gamma irradiation of trichloroethylene was established. Infrared analysis indicated the presence of radiolysis products with a low oxygen content. (auth)

35624 THE RADIATION AND PHOTOCHEMICAL BEHAVIOR OF A NUMBER OF Co(III) HEXAMMINES. L. N. Neokladnova and G. A. Shagisultanova. Radiokhimiya, 6: 305-14(1964). (In Russian)

Solutions of 0.01, 0.001, and 0.002 M in $[Co(NH_3)_6](NO_3)_3$ or $[Co(en)_3](NO_3)_3$ were irradiated with 20,000 to 30,000 R of γ or ultraviolet rays. The radiolytic changes were followed spectrophotometrically and by noting the change in pH. The $[Co(NH_3)_6](NO_3)_3$ solution gave a dark brown precipitate with the composition of $Co(OH)_3$. The radiolytic and photolytic decomposition took place most readily with 0.001 M solution of the cobalt hexammine. Acidification of the irradiated cobalt hexammine solution with 0.1 N $HClO_4$ led to conversion of an intermediate hydroxy complex to an aquo complex, whose spectrum is similar to the initial hexammine spectrum. This behavior indicates that the decomposition of the Co(III) hexammine passes through intermediate stages where aquo and hydroxy complexes are formed. The $[Co(en)_3](NO_3)_3$ solution does not give a $Co(OH)_3$ precipitate on irradiation, but does form aquo and hydroxy complexes having the composition $[Co(en)_2(H_2O)_2]Cl_3$ or $[Co(en)_2OHCl]Cl_2$. The ethylene complex is much more stable to the action of γ radiation and to light irradiation than the cobalt hexammine complex. The radiolytic processes occurring in the solution of the cobalt ethylene complex are readily reversed by acidifying the solution. (TTT)

35625 THE INTERACTION OF TRITIUM RECOIL ATOMS WITH TERPENES. An. N. Nesmeyanov, Lyan-shen Van, and A. Bekker. Radiokhimiya, 6: 314-23(1964). (In Russian)

A sample of α-pinene, dipentene, limonene, pinane, menthane (hexahydrocymene), or p-cymene was mixed with 50% by weight of Li_2CO_3, and irradiated in quartz ampoules

for 0.5 to 100 hours at a neutron flux of 1×10^{12} neutrons/sec · cm^2. The irradiated mixture was separated by gas chromatography, and the individual products were identified from the thermal conductivities of fractions from an artificial mixture, and from the hold-up time of the individual product on the column. All the separations were excellent except for the separation of dipentene from limonene. The data show that the irradiation of 1 gram of α-pinene for 10 hours will produce a limonene product having a specific activity of 26 μC/g after addition of 0.1 g limonene as an inert carrier. An internal molecular bridge is broken in this case. The specific activity of limonene is 14 μC/g, and that of dipentene is 6.4 μC/g after a two hour irradiation of these compounds. Here a hydrogen atom is replaced by the hot tritium atom, and the intermediate excited molecule or radical is stabilized by recombination and formation of the parent molecule. A dipentene product with a specific activity of 26 μC/g is obtained on irradiating 1 g of pinane for two hours and adding 0.1 g of inactive dipentene as a carrier. Dehydrogenation takes place during the reaction in this case. The irradiation of 1 g of menthane for 2 hours results in the formation of 6 μC of pinane and of 6 μC of dipentene. The specific activity is 60 μC/g with 0.1 g of added carrier. These methods are useful in obtaining tritium-tagged terpene compounds. (TTT)

35626 THE BEHAVIOR OF TRITIUM RECOIL ATOMS IN A NUMBER OF BINARY SYSTEMS. E. N. Avdonina, An. N. Nesmeyanov, and Khao-min Un. Radiokhimiya, 6: 323-9(1964). (In Russian)

A volume of 0.02 ml of a binary mixture of organic compounds (cyclopentane-benzene, cyclohexane–pyridine, and pyridine–benzene) was mixed with 20 mg of Li_2CO_3, and irradiated 15 minutes in a neutron flux of 0.87×10^{13} neutrons/cm^2 · sec. The tritium recoil atoms were stabilized by formation of a simple replacement product tagged with tritium. HT is the principal by-product. The samples were analyzed by gas chromatography. The data show that the increasing mole fraction of the aromatic component (pyridine or benzene), the retention of tritium atoms in the hydrocarbon fraction (cyclopentane or cyclohexane) increases, and the increase in specific activity of the cyclopentane or cyclohexane is directly proportional to the content of benzene or pyridine. The yields of the components are not additive. The aromatic component shows a protective effect. With the benzene–pyridine mixtures, the specific activity of benzene in the pyridine mixture increases with increasing mole fraction of pyridine, and in all cases the specific activity of benzene in the irradiated mixture exceeds the specific activity of pure, irradiated benzene. A greater protective effect of an aromatic compound as compared to a hydrocarbon compound is due to the lower excitation and ionization potentials of aromatic compounds. (TTT)

35627 THE CHEMICAL FORMS OF RADIOACTIVE ^{76}As FORMED DURING THE NEUTRON IRRADIATION OF PHENYLARSONIC ACID, AND THE PREPARATION OF ENRICHED ^{76}As PRODUCTS. N. P. Rydenko, T. M. Shuvaeva, and N. I. Mertts. Radiokhimiya, 6: 329-35(1964). (In Russian)

Solid samples of benzenearsonic acid $AsO(OH)_2C_6H_5$, and aliquots of a 0.1 M aqueous solution of benzenearsonic acid were irradiated with neutrons in order to produce tagged compounds of ^{76}As. Preliminary tracer experiments showed that the following procedure was the best for determining the distribution of As^{5+}, As^{3+}, and $AsO(OH)_2C_6H_5$ in the irradiated sample. First, AsO_4^{3-} is precipitated from an ammoniacal solution as the magnesium ammonium arsenate compound. Then, AsO_3^{3-} in the filtrate is oxidized to AsO_4^{3-} with iodine or hydrogen peroxide, and the oxidized product AsO_4^{3-} is again precipitated as the magnesium ammonium arsenate compound. Finally, benzenearsonic acid is precipitated from HCl solution as the zirconium benzenearsonate compound. Other variations of this method were unsuitable and could not be used. With a total neutron dose of 10^{10} to 10^{11} neutrons/cm^2 and an irradiation time of 0.5 to 10 hrs, the distribution of ^{76}As activity is 75% as As^{3+}, 5% as As^{5+}, and 20% as $AsO(OH)_2C_6H_5$. With a neutron dose of 10^{12} to 10^{14} neutrons/cm^2 and an irradiation time of 40 to 50 hours, the distribution was 90% as As^{3+}, 9% as As^{5+} and 1% as $AsO(OH)_2C_6H_5$. Distillation from a hot HCl solution leads to exchange between the various forms of arsenic. (TTT)

35628 REACTIONS OF HOT TRITIUM ATOMS WITH ETHYLENE IN THE GASEOUS PHASE. B. G. Dzantiev and A. P. Shvedchikov. Radiokhimiya, 6: 371-2(1964). (In Russian)

Ethylene mixed with ammonia or helium was irradiated with neutrons in the presence of Li_2CO_3. Tritons were formed by a $^6Li(n,\alpha)T$ reaction. The reaction products were analyzed by gas chromatography. In pure ethylene the primary tagged product is HT; the yields of C_2H_5T, C_2H_3T, and C_4H_9T are 8, 27, and 40% of the HT yield, respectively. On adding ammonia gas to the system, the yields of C_2H_5T and C_4H_9T vary only slightly. The ratio of C_2H_5T to C_4H_9T is 0.2. This ratio approaches 1, when a thin layer of ^6LiF or ^6LiOH is used in place of Li_2CO_3 crystals. The addition of helium to ethylene decreases the HT yield. The yield of C_2H_3T is also decreased. Hence, it is possible that C_2H_3T is formed by the following hot reaction: $T^* + C_2H_4 \rightarrow C_2H_3T + H$. (TTT)

35629 GASEOUS REACTIONS OF HOT ^{14}C ATOMS IN THE ETHYLENE–AMMONIA SYSTEM. B. G. Dzantiev and A. P. Shvedchikov. Radiokhimiya, 6: 373-5(1964). (In Russian)

On irradiating a mixture of ethylene and ammonia in a nuclear reactor, hot ^{14}C atoms with E = 40 kev are generated by a $^{14}N(n,p)^{14}C$ reaction in the gaseous phase. The irradiation was carried out at a thermal neutron flux of 1.2×10^{11} neutrons/cm^2-sec, and at a γ dose rate of 1×10^{14} ev/cm^3-sec. The gas mixture was sealed in a quartz ampoule with a volume of 15 to 20 cm^3 at a pressure of 5 to 7 atm, and was irradiated for 70 to 100 hours. The reaction products were analyzed by gas chromatography. The solid polymeric product was leached from the ampoule with warm benzene. The ^{14}C activity was determined on an end-window beta counter. The principal tagged product on irradiating pure ammonia is $^{14}CH_4$. The yield of $^{14}CH_4$ decreases on increasing the amount of ethylene in the initial ethylene-ammonia mixture. The $^{14}CH_4$ is formed by the reaction of ^{14}C with ammonia and not with ethylene: $^{14}C + NH_3 \rightarrow {}^{14}CH_4$. A ^{14}C polymer, which contains 80 to 90% of the total activity, is also formed. The yield of tagged polymer is a maximum with the addition of 2% ethylene to the ammonia gas. The yield of tagged polymer is a maximum with the addition of 2% ethylene to the ammonia gas. The yield of ^{14}C-polymer is dependent on the initial ethylene concentration. The polymer is a colorless compound at low C_2H_4 concentrations, and turns into a viscous brown liquid at higher C_2H_4 concentrations. (TTT)

35630 AN IMPROVED TRAIN FOR THE PRODUCTION OF O^{18}-LABELED AIR. C. R. Jensen, J. Letey, and L. H. Stolzy (Univ. of California, Riverside). Soil Sci. Soc. Am. Proc., 28: 580-1(July-Aug. 1964).

A system is described for the production of ^{18}O-labeled air by electrolysis of a solution of D_2O (or H_2O) enriched in ^{18}O and containing potassium acetate as the electrolyte. (D.C.W.)

35631 RESEARCH IN RADIATION CHEMISTRY AND ITS INDUSTRIAL APPLICATIONS. Rolf E. Buehler. TVF (Tek. Vetenskaplig Forskning), 35: 102-11(1964).

A review is presented on the present status of industrial applications of radiation chemistry. Existing commercial processes are listed and radiation sources and factors influencing the choice of radiation sources are discussed. Methods of basic research are briefly discussed. (P.C.H.)

35632 DISSOCIATION OF MOLECULES IN STRONG RADIATION FIELD. F. V. Bunkin, R. V. Karapetyan, and A. M. Prokhorov (Lebedev Inst. of Physics, Moscow). Zh. Eksperim. i Teor. Fiz., 47: 216-20(July 1964). (In Russian)

Photodissociation of molecules in a strong (laser) radiation field is considered for $\hbar\omega < D_0$, where D_0 is the dissociation energy. The mechanism of dissociation of polar diatomic molecules by strong buildup of their oscillations is analyzed in detail. The analysis is carried out by perturbation theory and the probabilities for two and three photon dissociation are calculated. Numerical estimations show that the dissociation process due to the mechanism under consideration should be observable. (auth)

35633 ON THE THEORY OF SENSITIVITY OF IONOGRAPHIC EMULSIONS. I. VALUE OF SENSITIVITY CENTER IN A GRAIN. S. V. Izmailov. Zh. Nauch. i Prikl. Fotogr. i Kinematogr., 7: 433-43(1962). (In Russian)

The theory of emulsion sensitivity was based on an hypothesis that the sensitivity fluctuations in individual grains play the most important role. An analysis was made using silver halide emulsion and assuming the sensitivity center in the grains is equal to zero or one. (R.V.J.)

35634 RECOIL TRITIUM REACTIONS WITH CYCLOBUTANE. Kyung Chai Lee. Thesis, Lawrence, Kan., Univ. of Kansas, 1963. 183p.

Cyclobutane was chosen as a suitable target molecule for the investigation of the excitation energies of the cyclo-C_4H_7T molecules formed by the T-for-H reaction at the C–H bond in cyclo-C_4H_8. The excited cyclo-C_4H_7T decomposes in gas phase to C_2H_3T and C_2H_4 by a unimolecular decomposition, or may be de-excited to the stable cyclo-C_4H_7T by collision with the other molecules in the system. In the presence of O_2 as a scavenger molecule, recoil tritium atoms react with cyclobutane to form mainly cyclo-C_4H_7T, C_2H_3T, and HT. In the pressure range 0.07 to 1 atmosphere, the sum of cyclo-C_4H_7T and C_2H_3T yields is constant, but the fraction of this sum found as cyclo-C_4H_7T rises smoothly from 47% to 60%. In the liquid phase, the cyclo-C_4H_7T/C_2H_3T ratio is 4.6. The observed pressure dependence demonstrates the formation in the initial hot reaction of cyclo-C_4H_7T with sufficient excitation energy to cause unimolecular decomposition to C_2H_3T. The trend with pressure indicates a broad distribution of excitation energies for cyclo-C_4H_7T molecules with a median energy of approximately 5 ± 1 ev. The calculations of the excitation energies were performed using both the specific rate constant expression from the classical formulation of Rice, Ramsperger, and Kassel and that from the quantum statistical formulation of Rice and Marcus. (Dissertation Abstr., 24: No. 12, Pt. I (June 1964))

35635 RADIOCHEMICAL DECOMPOSITION IN IRON COMPLEXES. E. Koerner von Gustorf, H. Koeller, M. J. Jun, and G. O. Schenck (Max-Planck-Institut für Kohlenforschung, Mulheim, Ger.). p.259-64 of "Atomstrahlung in Medizin und Technik." Munich, Verlag Karl Thiemig KG, 1964. (In German)

The preliminary results obtained in the study of the radiochemical preparation of metallorganic compounds are illustrated with two examples. The first is the irradiation of ferrocene in CCl_4 and CBr_4 for which the G values for the decomposition of ferrocene were determined. The mechanism of the radiochemical reaction of CCl_4 with ferrocene was determined. The behavior of maleic acid anhydride and iron tetra- and pentacarbonyl in benzene under γ irradiation was the second example. The decompositions observed were graphed. (J.S.R.)

35636 PRIMARY RADIOCHEMICAL PROCESSES IN RADIOLYSIS OF WATER. D. Schulte-Frohlinde and K. Eiben (Kernforschungszentrum, Karlsruhe, Ger.). p.265-72 of "Atomstrahlung in Medizin und Technik." Munich, Verlag Karl Thiemig KG, 1964. (In German)

The formation of the hydrogen radical in the radiolysis of water can occur by the mechanism of the dissociation of a water molecule excited by the radiation or by the reaction of a solvated electron with a proton or a water molecule. Indirect methods used to detect the presence of solvated electrons are reviewed. A direct method is the ESR spectrum. Two mechanisms for the formation of solvated electrons are proposed and discussed. The mechanism for the formation of molecular hydrogen and the behavior of the H_2O^+ radical are discussed. (J.S.R.)

35637 PRODUCTION OF CHLORINE-36-LABELED TRICHLOROETHYLENE BY CHLORINE EXCHANGE. FIRST ATTEMPTS AT APPLICATION TO THE STUDY OF CORROSION PROCESSES. P. Siklós, L. Wiesner, and E. Wagner (Technische Hochschule, Hanover). p.273-9 of "Atomstrahlung in Medizin und Technik." Munich, Verlag Karl Thiemig KG, 1964. (In German)

The preparation of trichloroethylene-^{36}Cl by ion exchange with labeled aluminum chloride was studied. The best yield was obtained at the molecular ratio of 1 : 30 trichloroethylene to $AlCl_3$ when the reaction lasted for 10 hrs at 67°C. In order to determine chlorine traces left after treatment of a construction material surface, finely polished metals were placed in contact with labeled trichloroethylene for periods between 1 and 900 min. The samples were then dried at 100 to 120°C. The activity remaining on the metal samples after treatment and drying was measured. Results obtained for a ferritic steel, austenitic steel, nickel alloy, and platinum are tabulated. Significantly smaller amounts of ^{36}Cl were left on the Ni alloy. The mechanism for the formation of HCl on the surface of the metal samples cleaned with the trichloroethylene is discussed. (J.S.R.)

35638 RADIOCHEMICAL FORMATION OF HYDRAZINE AND ANILINE. Eberhard Schwarz (Institut fur Anorganische Chemie und Kernchemie, Mainz). p.284-9 of "Atomstrahlung in Medizin und Technik." Munich, Verlag Karl Thiemig KG, 1964. (In German)

The radiochemical formation of hydrazine during the γ irradiation of liquid ammonia and of aniline during the γ irradiation of benzene and ammonia mixtures was investigated. The effects of a number of parameters—irradiation of ammonia alone, addition of water or benzene, addition of sensitizing or catalyzing agents, dose output, total dose, presence of air, temperature—on the hydrazine yield were investigated. The effects of the same parameters on the radiochemical formation of aniline were also determined.

Possible mechanisms are suggested for both reactions. (J.S.R.)

Separation Processes and Procedures

Refer also to abstract 35678.

35639 (DP-872) DISSOLUTION OF ZIRCONIUM ALLOY FUELS IN 309SCb STAINLESS STEEL VESSELS. Edward S. Occhipinti and J. Harding Owen (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). June 1964. Contract AT(07-2)-1. 23p.

Tests were made to define the conditions for dissolving zirconium and zirconium–uranium alloys in 309SCb stainless steel vessels without excessively corroding the vessels. The optimum dissolvent found was an agitated solution of 1M HNO_3 at 70°C with a small stream of concentrated hydrofluoric acid injected continuously near the agitator. Under these conditions, ten tons of zirconium alloy can be dissolved in successive charges over a period of two to three weeks with less than one mil of vessel corrosion. (auth)

35640 (IS-849) A FINITE DIFFERENCE MODEL OF THE PULSE COLUMN. Stanley B. Collins and L. E. Burkhart (Ames Lab., Ames, Iowa). July 1963. Contract W-7405-eng-82. 37p.

Equations for a stagewise model of the pulse column were developed using the approach of Burkhart and Fahien. The model represents operation of the column in the mixer-settler region at steady state. Linear equilibrium lines, nonequilibrium contact, zero organic recycle, and equal holdup in all stages were assumed for the analysis. The resulting set of equations was solved using finite difference calculus. A closed form general solution resulted. The general solution was programed for digital computer evaluation because of the complex nature of the expressions required for the evaluation of the arbitrary constants in the general solution. The model predicted performances close to those obtained experimentally by Burkhart and Fahien. (auth)

35641 (ORNL-TM-785) UNIT OPERATIONS SECTION MONTHLY PROGRESS REPORT, SEPTEMBER 1963. M. E. Whatley, P. A. Haas, R. W. Horton, A. D. Ryon, and J. C. Suddath (Oak Ridge National Lab., Tenn.). Aug. 1964. Contract W-7405-eng-26. 34p.

A study was initiated on heat transfer in vertical cylindrical channels by natural convection in connection with the shipment of spent reactor fuel elements. The single vessel concept for the fused salt volatility process was tested with five dissolution-fluorination cycles and two additional fluorinations in an Alloy 79-4 vessel. The dissociation rate for the Zr–U elements averaged 1 mg-cm^{-2}-min^{-1} and the vessel corrosion rates were 0.53 mils/hr of fluorine exposure. Work in waste processing development comprised the completion of tests R-79 and R-80 in which sodium monobasicphosphate and lead oxide were added to TBP-25 waste to make a glass. Test R-80 was, in essence, a continuation of R-79 which was terminated after 13 hrs because of fouling of the off-gas line. This difficulty recurred in test R-80 but regular backflushing allowed the run to be completed. (auth)

35642 (ORNL-TM-798) UNIT OPERATIONS SECTION MONTHLY PROGRESS REPORT, JANUARY 1964. M. E. Whatley, P. A. Haas, R. W. Horton, A. D. Ryon, J. C. Suddath, and C. D. Watson (Oak Ridge National Lab., Tenn.). July 1964. Contract W-7405-eng-26. 61p.

In studies on the mechanism of drop coalescence in liquid-liquid systems, alpha irradiation was found to significantly increase the rate of coalescence and fission fragment irradiation resulted in almost immediate coalescence upon impact of the drop with a plane interface. Kinetics studies of the sorption of H_2O or CO_2 by molecular sieves has shown the rate mechanism to be describable by intracrystalline diffusion in the micropores, and that intercrystalline and external film diffusion are not significant factors. A parameter-search calculation using the CDC 1604-A computer determined the effective diffusivity of H_2O and CO_2 in the molecular sieves using data from differential bed runs. Tests conducted leaching ThO_2–UO_2 pellets from sheared stainless steel fuel elements showed that air sparging significantly decreased the time for dissolution, that ½-in. long pieces dissolved more rapidly than 1-in. long pieces, that a basket with 0.020-in.-diam holes and 24% free area was the best basket tested for holding the chopped pieces, and that little advantage was gained by adding the leachant in two parts. The shortest time required for 99.9% core dissolution was 6.7 hr. A system for continuous conversion of high level aqueous waste solutions to molten glass was demonstrated in engineering-scale equipment. Concentrated aqueous waste containing added phosphate and lead are continuously fed to the surface of a shallow pool of molten glass. (auth)

35643 (ORNL-TM-823) UNIT OPERATIONS SECTION MONTHLY PROGRESS REPORT, OCTOBER 1963. M. E. Whatley, P. A. Haas, R. W. Horton, A. D. Ryon, J. C. Suddath, and C. D. Watson (Oak Ridge National Lab., Tenn.). Aug. 1964. Contract W-7405-eng-26. 66p.

For the GCR coolant purification program, experiments were made to establish the mechanism for co-sorption of H_2O and CO_2 by fixed beds of molecular sieves. A mathematical model to predict the rate of this sorption is being prepared for digital computer solution. Zircaloy-2 prototype fuel tubes were sheared to determine the extent of the fire hazard. The operation proceeded easily and no evidence was found of temperature high enough to have formed a detectable oxide skin, oxygen contamination, or annealing of the grain structure. Studies in solvent extraction comprised operating pulsed columns for the extraction of uranium at extreme flow rate ratios (A/O) of 50 and 100. Stage heights at these ratios were about two to three times greater than those at the more conventional ratio of 5. For the waste processing program, a rising level TBP-25 glass producing run was made (R-81). Dust accumulating in the off-gas line caused some difficulty. (auth)

35644 (ORNL-TM-836) UNIT OPERATIONS SECTION MONTHLY PROGRESS REPORT, FEBRUARY 1964. M. E. Whatley, P. A. Haas, R. W. Horton, A. D. Ryon, J. C. Suddath, and C. D. Watson (Oak Ridge National Lab., Tenn.). Aug. 1964. Contract W-7405-eng-26. 30p.

The correlation of flooding data for solvent extraction pulsed columns was extended to consider four methods of introducing and removing the solvents. An apparatus was built for determining the vapor-liquid equilibria of the NbF_5–UF_6 system and experimental procedures are described. Waste processing run R-82 was a rising level glass test using FTW-65 waste with lithium, phosphate, and calcium added. Operating details and results of the run are reported. (auth)

35645 (SC-DC-64-1097) FORMATION AND DISPERSAL OF BERYLLIUM COMPOUNDS. Quarterly Progress Report. Glenn A. Whan (New Mexico. Univ., Albu-

querque. Engineering Experiment Station). June 1964. For Sandia Corp., Albuquerque. Contract [AT(29-1)-789]. 18p.

The determination of conditions under which beryllium particles of respirable size can be released to experimental atmospheres is studied. A design analysis of the proposed experimental apparatus is discussed. Design calculations for the gas dryer, heat exchanger, and vacuum pump are described. (N.W.R.)

35646 (TID-3312(Suppl.1)) REPROCESSING OF IRRADIATED FISSION REACTOR FUEL AND BREEDING MATERIALS. An Annotated Bibliography of Selected Literature. James M. Jacobs, comp. (Division of Technical Information Extension, AEC). June 1964. 206p.

A total of 1035 abstracts covering the unclassified literature from 1958 to 1964, is presented. The abstracts are arranged into sections dealing with criticality and safety, commercial aspects, head-end processing (feed preparation), fuel material separation and decontamination, bibliographies, conferences, and progress reports. Author, corporate author, report number, and availability indexes are given. (D.L.C.)

35647 (TID-7695(p.355-62)) ISOTOPE RECOVERY FROM A NUCLEAR DETONATION IN SALT. D. G. Karraker (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.).

The production of isotopes by the detonation of a nuclear device involves recovery of the debris from a contained explosion, and separation of the products from the shot debris by chemical processing. The choice of a salt formation for explosion of the device is extremely favorable for chemical processing, since the solubility of salt in water affords a natural beginning for recovery in an aqueous system. The major problem of chemical processing is the separation of a few ppb of product isotopes from the mass of salt and other minerals present in the shot debris. A simple model of the nuclear production process and data from the debris of the Gnome experiment indicates that the product isotopes are associated in the debris with minerals of roughly the same volatility; thus a "carrier" mineral retains most product isotopes and permits the removal of the salt by water leaching without significant loss of most products. The product isotopes are concentrated and recovered by chemical processing of the carrier. Processing methods that can be applied to the recovery of isotopes of the alkali, alkaline earth, rare earth, actinide, and transition metals are outlined. (auth)

35648 ION REMOVAL AND ITS APPLICATION TO RADIOACTIVE EFFLUENT TREATMENT. D. Pepper (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Brit. Chem., Eng., 9: 510-16(Aug. 1964).

Methods available for removing ions from solution are reviewed. The mechanism of each method is briefly described and the possibility of applying the processes to radioactive effluent treatment is discussed, the costs of some effluent treatment schemes being estimated. (auth)

35649 FRACTIONAL ENRICHMENT IN LANTHANUM OF THE MIXTURE OF OXIDES OF RARE EARTH ELEMENTS FROM A COMPLEXED SOLUTION. Krystyna Bańczykówna and Boguslaw Borkowski. Przemysl Chem., 43: 308-10(June 1964). (In Polish)

A method of separating a mixture of rare earth oxides into two fractions, one of which is to be enriched in lanthanum, is described. The method consists in partial complexing of rare earth chlorides in aqueous solution with disodium versenate and subsequent precipitation of the non-complexed part using ammonium oxalate. At adequately chosen experimental parameters lanthanum undergoes enrichment in the fraction of the non-complexed part. From the mixture of oxides containing 44% La_2O_3, a fraction with 65% La_2O_3 content was obtained in a single operation. The enrichment process, repeated four times, yields a fraction with above 80% La_2O_3 content. The part of lanthanides, remaining in the form of complexes in the solution impoverished in lanthanum, may be directly separated on ion exchangers. Experiments on enriching in lanthanum artificial mixtures of La_2O_3 and Nd_2O_3 showed that mixtures poor in lanthanum gave the best enrichment results. (auth)

35650 AN APPARATUS DESIGNED FOR HIGH-ACTIVITY RAPID LIQUID-LIQUID EXTRACTIONS. H. Muenzel (Kernforschungszentrum, Karlsruhe, Ger.). p.209-10 of "Atomstrahlung in Medizin und Technik." Munich, Verlag Karl Thiemig KG, 1964. (In German)

A special separation stirrer was developed for rapid liquid-liquid extraction in radiochemical separations. The device consists of a stirrer with a good mixing effect whose interior is built as a centrifuge. A cross section of the device is given, and its advantages are discussed. (J.S.R.)

35651 DISSOLVER POT (Engineering Materials). (Dow Chemical Co. Rocky Flats Plant, Denver). (CAPE-1105)

This simple device is used for the dissolution of plutonium skulls. The pot is made from Pyrex pipe 6 in. ID and 12 in. long. Each end is sealed by a flanged-plate lid made of stainless steel and T elbow, and is fastened with swing bolts. The bottom lid assembly is perforated and provides for a reservoir and filter, both made of Teflon. For a title listing, see the Engineering Materials List (TID-4100). (C.E.S.)

35652 JUMPER CHECKING JIG [PUREX FACILITY] (Engineering Materials). (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). (CAPE-1109)

Drawings (18) are included for the mechanical jumper checking jig that permits the fabrication of Hanford Jumpers to tolerances of $\pm 1/16$ in. It is flexible in application and permits a wide variety of jumper sizes and configurations to be fabricated when over-all dimensional accuracies must be maintained to permit in-cell installation by remote handling methods. The jigs were designed in 1953 for the Purex facility. For a listing of individual titles, see the Engineering Materials List (TID-4100). (C.E.S.)

35653 METHOD FOR THE SEPARATION OF PLUTONIUM, GOLD, PLATINUM, PALLADIUM, THALLIUM, VANADIUM, URANIUM, RUTHENIUM, RHODIUM, COPPER, NICKEL, COBALT, OR CHROMIUM FROM SOLUTIONS. Charles Arthur Fetscher (to Nopco Chemical Co.). German Patent 1,169,908. May 14, 1964. Filed May 16, 1960.

The solutions are treated with granulated or thready polyamidoximes at a pH value of at least 1. By this treatment the ions of the metals are adsorbed by the particles of polyamide composition. (Gmelin Inst.)

ENGINEERING

General

35654 (HW-73641) A LIST AND DESCRIPTION OF LEAK DETECTION METHODS. Jerry J. Cadwell (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). June 8, 1962. Contract AT(45-1)-1350. 11p.

The choice of a leak detection method depends on one or more of the following factors: (1) the maximum allowable leakage rate, (2) the complexity of the detection equipment, (3) the maximum allowable hole size, and (4) the time during which the leakage must be minimum. A method is presented of selecting from graphs the most suitable method for a given situation. (auth)

35655 (IITRI-528-20) APPROXIMATE BURSTING STRENGTH OF THIN-WALLED CYLINDERS WITH HEMISPHERICAL CAPS. Summary Report. C. J. Costantino and M. A. Salmon (Illinois Inst. of Tech., Chicago. IIT Research Inst.). [1962]. Contract AT(11-1)-528. 69p.

An approximate solution is presented for the bursting strength of thin-walled cylinders with hemispherically capped ends. Deformation theory of plasticity is used, together with the Mises yield criterion. Solutions are presented for hardening materials obeying both the Ludwik power hardening law and a linear strain hardening law. Comparisons of the results are made with the results for cylinders with rigid ends to determine the influence of end restraint on burst pressure. Numerical results are presented for cylinder lengths from zero (sphere) to infinity, and for a range of hardening coefficients. (auth)

35656 (IS-817) LIQUID-PHASE MASS TRANSFER AT LOW FLOW RATES IN A PACKED COLUMN. John Earnest Frandolig and R. W. Fahien (Ames Lab., Ames, Iowa). Feb. 1964. Contract W-7405-eng-82. 125p.

Liquid-phase mass transfer in a packed bed was investigated for flow conditions for which the effect of neglecting axial transfer in the prediction of concentration distributions would most likely be significant. The purpose of this study was twofold: (1) to obtain experimental concentration data suitable for comparison with future theoretical studies, and (2) to analyze these data in terms of calculated effective axial and radial diffusivities and Peclet numbers. The experimental work consisted of measuring radial concentration distributions for a dye being transported in a main stream of water flowing through a 3.97-inch ID column packed with 0.262-inch spherical particles. Data were obtained at four axial levels above a centrally located injection tube for Reynolds numbers between 7.1 and 84.9. Samples were removed from the column by a specially designed probe assembly which "averaged" the samples for a given radial position over a number of angular positions. Analysis of the data was made in accordance with a solution of the boundary value problem set up to describe the physical system. The solution considered the variation of the diffusivities and the flow distribution with radial position. Axial and radial Peclet numbers were calculated for the first time from the data of a single experiment. Values of the axial Peclet number were found to be approximately one-hundredth of those of the radial Peclet number. Hence, the axial diffusivity is approximately one hundred times greater than the radial diffusivity for the conditions of this study. Although the axial diffusivity was found to be much larger than the radial diffusivity, the effect of including axial transfer in the prediction of concentration distributions was shown to be quite small. The variation of the radial diffusivity with radial position was found to be much less pronounced than for gas-flow systems as determined by previous investigators. (auth)

35657 (LA-2929) MEC-21/7094 — A PIPING FLEXIBILITY ANALYSIS PROGRAM FOR THE IBM-7090 AND 7094. James H. Griffin (Los Alamos Scientific Lab., N. Mex.). July 1963. Contract W-7405-eng-36. 195p.

MEC-21/7094 is a computer program using tensor analysis methods to analyze the flexibility of multiple branch and closed-loop piping systems subject to thermal, uniform, and concentrated loadings, and is also applicable on cryogenic piping systems. All computations are performed in accordance with the requirements of ASA B31.1-1955, American Standard Code for Pressure Piping. As an incidental feature, the program is also able to solve certain structural problems. It is written in FORTRAN II and will operate on either the IBM-7090 or 7094. The maximum problem size is 99 branches, 99 branch-intersection-points, and/or 999 data points. Each data point may describe one to three elements. Machine time varies between 0.02 and 0.05 minute per element, depending on the complexity of the system. The application of the program is described and instructions are given for its use. Detailed instructions for preparation of the input data are included as well as a number of illustrative examples. (auth)

35658 (LAMS-3081) THE EFFECT OF LATERAL INERTIA ON THE PROPAGATION OF PLASTIC STRAIN IN A CYLINDRICAL ROD. G. P. DeVault (Los Alamos Scientific Lab., N. Mex.). Apr. 1964. Contract W-7405-eng-36. 37p.

It is reasonable to expect that under rapid dynamic loading, lateral inertia effects would play a significant role in the propagation of an elastic-plastic pulse along a bar. The one-dimensional approximate equations of elasticity are modified to include the effect of lateral inertia. These equations are solved analytically for step-function loading. The equations are then differenced and the stability of the resulting difference equations is discussed. Numerical solutions of the difference equations are compared with the analytic solutions. The equations are then modified to allow for plastic deformation and hysteresis in addition to the lateral inertia effect and are solved numerically. These solutions are compared with the results of strain-rate dependent and strain-rate independent theories. It is concluded that some observations set forth as proof of the existence of a strain-rate effect might equally be explained, at least qualitatively, on the basis of a lateral inertia effect. (auth)

35659 (ORNL-3648) A COMPUTER CODE (CDC 1604A OR IBM 7090) FOR CALCULATING THE COST OF SHIPPING SPENT REACTOR FUELS AS A FUNCTION OF BURNUP, SPECIFIC POWER, COOLING TIME, FUEL COMPOSITION, AND OTHER VARIABLES. Royes Salmon (Oak Ridge National Lab., Tenn.). Aug. 1964. Contract W-7405-eng-26. 72p.

The calculation of the costs incurred in shipping irradiated uranium-containing fuel elements is discussed. A computer code that designs a cask and calculates the shipping costs is presented. This code, designated MYRA, may be run on either the CDC 1604A or the IBM 7090. By use of the code, shipping costs were calculated for typical

reactor fuels. These results are used to illustrate the effect of burnup, specific power, and other variables. The code includes calculation of the length of time required for the accumulation of a reprocessing batch of given size. This takes into account the scheduling and batch sizes of the discharge, shipping, and reprocessing operations. Criticality calculations are not included. It is assumed that criticality can be prevented by using permanent poisons in the metal divider plates between the fuel elements. The code will be useful to those who are concerned with optimal shipping procedures, schedules, and cask designs. (auth)

35660 (RTD-TDR-63-3041(Vol.III)) EVALUATION OF TUNNEL LINERS IN GRANITE SHOT HARDHAT, OPERATION NOUGAT. STATIC STRESS-STRAIN CURVES FOR VARIOUS MATERIALS INVESTIGATED FOR USE AS PACKING. Final Report. L. H. Klotz (Illinois. Univ., Urbana). Feb. 1964. Contract AF29(601)-4993. 114p. (AD-433191)

Results are given of tests of various materials which were considered for use as shock isolating media in the Hard Hat tests. These tests were static compression and penetration tests, and the materials tested were of two types, granular cohesionless materials (cinders, coke, etc.) and elasto-plastic materials (plastics, concrete, etc.). The results are presented in the form of stress vs strain graphs. (D.L.C.)

35661 (TID-4100(Suppl.23)) SUPPLEMENTAL INSERT SHEETS FOR ENGINEERING MATERIALS LIST. Richard E. C. Duthie, ed. (Division of Technical Information Extension, AEC). Sept. 1964. 59p.

Included are lists under nuclear reactors and reactor facilities (La Crosse, ELPHR, BONUS, and instrumentation), centrifuges, stress-strain facility equipment, and CERN general-purpose chassis. (D.L.C.)

35662 (TID-7695(p.239-68)) LARGE-DIAMETER DRILLING FOR EMPLACING NUCLEAR EXPLOSIVES. Paul R. Fisher (Corps. of Engineers, Fort Worth, Tex.).

Techniques and costs have been studied for drilling large-diameter emplacement holes for nuclear explosives designed to produce craters: Limits of 66-in. i.d. (cased) and 2500-ft depth were chosen for the study. Of the three drilling methods studied–core, churn, and rotary–rotary drilling using a circulating fluid or gas was found to be the most wide-spread and to hold the greatest potential. Large-diameter rotary drilling required modifications in design of both drill bit and strings, in fluid circulation methods, and in casing design. Present costs will probably be greatly reduced as techniques and requirements become standardized. (auth)

35663 (TID-20936) STATUS SUMMARY OF APDA SMALL-LEAK SODIUM–WATER REACTION TEST PROGRAM. H. O. Muenchow (Atomic Power Development Associates, Inc., Detroit). June 30, 1964. Contract AT(11-1)-865. 11p.

The engineering, design, and procurement aspects are reviewed for a test loop whose purpose is the analysis of Na–water reactions caused by small leaks in Na-heated steam generators. The loop is also intended for studies of the progression of these small leaks into large leaks. (T.F.H.)

35664 EXPERIMENTAL RESULTS IN HIGH-SPECIFIC-IMPULSE THERMO-IONIC ACCELERATION. Adriano C. Ducati, Gabriel M. Giannini, and Erich Muehlberger (Giannini Scientific Corp., Santa Ana, Calif.). AIAA (Am. Inst. Aeron. Astronaut.) J., 2: 1452-54(Aug. 1964).

Some developments in thermo-ionic acceleration are discussed, using the results of tests on a water-cooled plasma generator with hydrogen propellant. Specific impulses greater than 10,000 sec were measured, and specific impulses approaching 20,000 sec appear possible. Projections of the results obtainable with impulses higher than 10,000 sec and a heat transfer efficiency of 90% are given. The contribution of magnetic forces to the acceleration was seemingly confirmed, and the effect of magnetic forces on the arc structure was studied. (D.C.W.)

35665 METHOD AND APPARATUS FOR THE IRRADIATION OF A CONTINUOUSLY ADVANCING MATERIAL WITH IONIZING RADIATION. Fritz Munzel and Willy Roth (to Heberlein Patent Corp.). U. S. Patent 3,142,754. July 28, 1964. Priority date Sept. 12, 1959, Switzerland.

A facility is designed for the irradiation of a material web, filament, tape, or the like while the material is continuously advanced in a plurality of passes adjacent to the radiation source. The radiation source is a thin elongated envelope enclosing a layer of several containers of radioactive material, and the material being irradiated is passed around the source by means of a series of driven rollers. (D.L.C.)

35666 MONORAIL PACKAGE IRRADIATION PLANT. Sidney Jefferson and Frank Rogers (to United Atomic Energy Authority). U. S. Patent 3,142,759. July 28, 1964. Priority date Jan. 20, 1960, Great Britain.

A monorail system is designed for conveying packages past a radiation source of sheet form in such a manner that each package receives a uniform dose and most of the 4π solid angle of the radiation is utilized. The operation of the system is described. (D.L.C.)

Applications of Nuclear Explosions

Refer also to abstract 35771.

35667 (RTD-TDR-63-3125) THEORETICAL STUDY OF ENERGY DISTRIBUTION IN A HALF-SPACE RESULTING FROM DYNAMIC LOADING IN A DEPRESSION AT THE ORIGIN. (General American Transportation Corp. MRD Div., Niles, Ill.). Mar. 1964. Contract AF29(601)-5813. 62p. (AD-438711)

An analysis of the free-field ground motion in the elastic region due to the energy delivered directly to the ground by a nuclear weapon is presented. The problem is approached along two different lines. One of these approaches treats the elastic region as a cratered half-space, where the hemispherical boundary of the crater is subjected to the pressure history exerted by a hydrodynamic region within the crater. The other approach treats the elastic region as a complete half-space, a portion of which has initial motion and pressures corresponding to the state of the hydrodynamic region at some instant when its behavior is becoming more nearly elastic than hydrodynamic. For the cratered-half-space approach, exact analytical expressions are obtained for the stresses at the wavefront, and numerical results based on these expressions are presented. For the complete-half-space approach, analytical results alone are obtained. (auth)

35668 (TID-7695) PROCEEDINGS OF THE THIRD PLOWSHARE SYMPOSIUM ENGINEERING WITH NUCLEAR EXPLOSIVES, APRIL 21-23, 1964. (California. Univ., Livermore. Lawrence Radiation Lab. and San Francisco Operations Office, AEC). Contract W-7405-eng-48. 408p.

A total of 30 papers are presented on topics relevant to engineering applications of nuclear explosives: Plowshare history, heavy isotope production and recovery, studies of nuclear reactions, craters, fallout and contamination, radiation hazards, blast and seismic waves, underground explosions, excavation, harbors, mining, etc. Separate abstracts were prepared for 23 of the papers. For abstracts of the remaining 7 papers, see NSA 18: 20126, 20125, 23752, 20122, 20124, 20127, and 27638. (D.L.C.)

For abstracts of individual papers see: 35647, 35662, 35669, 35670, 35671, 35672, 35673, 35674, 35675, 35676, 35705, 35706, 35707, 35717, 35768, 35769, 36081, 36556, 36557, 36892, 36893, 36894, and 36895.

35669 (TID-7695(p.3-6)) THE PLOWSHARE PROGRAM—HISTORY AND GOALS. Gerald W. Johnson (California. Univ., Livermore. Lawrence Radiation Lab.).

A brief discussion is given of the background of the Plowshare Program. The use of nuclear explosives to excavate a canal was first considered after the Suez crisis, and in 1957, a group was formed to study possible engineering uses of nuclear explosives. The results of Rainier and Gnome events are discussed briefly. (D.L.C.)

35670 (TID-7695(p.7-10)) CHARACTERISTICS OF NUCLEAR EXPLOSIVES. W. J. Frank (California. Univ., Livermore. Lawrence Radiation Lab.).

The characteristics of nuclear explosives of particular interest to mining and public works construction are cost, diameter, and radioactivity produced. The relationship between these properties is discussed in general terms within the limits of classification. A few specific data points are given. (auth)

35671 (TID-7695(p.269-88)) APPLICATIONS OF NUCLEAR EXPLOSIVES TO INCREASE EFFECTIVE WELL DIAMETERS. Henry F. Coffer, Bruce G. Bray, and Carroll F. Knutson (Continental Oil Co., Ponca City, Okla.).

Large, currently uneconomical, hydrocarbon reservoirs are known to exist in this country. The stimulation of such reservoirs by contained nuclear explosions is discussed. The effect of such an explosion is to increase the apparent well-bore diameter by creating a cavity, a chimney, and an associated annular fractured zone. This geometry results in a complex flow regime yielding increased productivity of the fluids present in the reservoir. A discussion of this flow regime and the economics of utilizing nuclear stimulation for a low productivity gas-bearing reservoir are considered. Under certain conditions, it is shown that such nuclear stimulation results in favorable economics for reservoir development. However, it is believed that current uncertainties in technology and the "economic risk factor" require testing of a nuclear device in a hydrocarbon-bearing, or at least more typical, reservoir formation. (auth)

35672 (TID-7695(p.305-8)) A PROPOSAL FOR A NUCLEAR POWER PROGRAM. George C. Kennedy (California. Univ., Los Angeles).

Substantial areas of the world are underlain by rocks of abnormally high temperature. In many places heat flow in these regions is as much as ten times that of the normal crust. Deeply buried nuclear explosives can be detonated and will produce rubble cones. The quantity of heat available in these rubble cones, made up of hot fragmented rock, is sufficiently large to appear economically interesting. A proposal is outlined for the mining of earth heat. Approximately five times as much energy is available from a cone of hot rubble as is released by the nuclear device which produces the rubble cone. (auth)

35673 (TID-7695(p.309-20)) APPLICATION OF NUCLEAR EXPLOSIVES FOR A MOUNTAIN PASS HIGHWAY AND RAILROAD. H. C. Prentice (California. State Div. of Highways, Sacramento).

A feasibility study was made of the nuclear excavation of a rock cut through the Bristol Mountains in California (Project Carryall). This cut would be about 2 miles long with a maximum depth of about 340 ft, and would require a row of 22 nuclear devices with a total yield of 1730 kilotons to remove a volume of 68 million cubic yards. The preliminary and safety studies that would be needed are discussed. An additional 100-kiloton crater is proposed to intercept runoff from a large drainage area. The cost of the nuclear excavation is compared with that of conventional excavation. It is concluded that Project Carryall is technically and economically feasible. (D.L.C.)

35674 (TID-7695(p.321-34)) NUCLEAR EXCAVATION OF A SEA-LEVEL, ISTHMIAN CANAL. E. Graves (Corps of Engineers).

The feasibility of digging a sea-level, Isthmian canal by nuclear explosions depends on several major factors. One is the availability of suitable alternative sites. Another is the ability to make stable excavations of adequate size by means of large explosions. A third is the ability to control the potential safety hazards. Still another is the time, effort, equipment, and materials required for the nuclear excavation and major conventional construction necessary to complete an operating inter-oceanic waterway. Integration of these factors into an overall plan leads to an assessment of feasibility in terms of safety, time schedule, and estimated total costs. (auth)

35675 (TID-7695(p.363-70)) EXCAVATION FOR WATER CONVEYANCE WITH NUCLEAR EXPLOSIVES. J. W. Keysor and M. B. Andrews (California. Dept. of Water Resources, Sacramento).

The West Side Conveyance System in California is a possible feature of future work for conveyance of water from the North Coastal area to areas of efficiency. Joint reconnaissance studies of this possible feature indicates substantial savings in cost may be possible if nuclear explosives can be used for excavation. Further studies are proposed for evaluation of hazards and engineering feasibility. (auth)

35676 (TID-7695(p.371-84)) COMPLETELY CONTAINED NUCLEAR EXPLOSIVES FOR MINING BY CAVING. S. M. Hansen and D. B. Lombard (California. Univ., Livermore. Lawrence Radiation Lab.).

Rock breaking technology utilizing contained nuclear explosions is reviewed, and applicable nuclear experiments are briefly summarized. A new design for an underground bulk mining method known as "nuclear caving" is described, and design and applicability comparisons are drawn with conventional block caving. Special safety aspects of the nuclear case are discussed, and a comprehensive economic evaluation of the two methods is made, based partly on applications of the design to existing orebodies. It is concluded that nuclear caving with the new design is more economical than with previously proposed nuclear designs, and that the new nuclear caving design has a substantial economic potential, compared to conventional block caving, in ore bodies of several million tons and larger. (auth)

Facilities and Equipment

35677 (HW-58563) INSTALLATION OF PNEUMATIC SOLIDS TRANSFER VALVES IN THE UO_3 PLANT. J. M. Gerhart (General Electric Co. Hanford Atomic Products

Operation, Richland, Wash.). Jan. 21, 1959. Contract AT(45-1)-1350. 12p.

The development of a pneumatic solids transfer valve showed that a valve utilizing a change in the angle of repose as a control mechanism was entirely feasible for use in a system requiring the flow control of UO_3 powder. Based on information gained from work with a small plastic model of the valve, a full size prototype was constructed and installed in a UO_3 plant. The successful operation of the prototype led to the construction of five additional valves so that the valve is now in use in six calciners. The performance of the entire pneumatic powder handling system has been improved due to the smoothing out of the powder flow. (P.C.H.)

35678 (ORNL-3656) THE JOINT NATIONAL INSTITUTES OF HEALTH–ATOMIC ENERGY COMMISSION ZONAL CENTRIFUGE DEVELOPMENT PROGRAM. Semiannual Report, July 1–December 31, 1963. (Oak Ridge National Lab., Tenn.). Aug. 1964. Contract W-7405-eng-26. 121p.

Work on methods for separating subcellular particles, including viruses is described. The major efforts were directed toward the development of integrated centrifugal systems for isolating trace quantities of virus from tissues, plasma, and culture fluids. It was found that when the sedimentation rates of subcellular particles are plotted against the particle banding densities, a vacant area, or window, appears in the area where most viruses would be plotted. To exploit this virus window, it was necessary to develop methods for separating masses of particulate material first on the basis of sedimentation rate and second on the basis of density, and to adapt analytical methods to the description of the separations. To translate these theoretical possibilities into reality, the B-IV zonal centrifuge was developed, together with methods for multiple-fraction isopycnic banding. The resolution of the system was studied using a variety of biological materials, and several types of virus particles were recovered in a high state of purity from tissue breis. The applicability of this system to the problem of searching human tumors for virus-like particles is now being explored. Before this can be effectively done, however, a survey of normal tissue components isolated by these systems is required. By use of a simplified system for particle isolation, virus-like particles were consistently recovered from human leukemic plasma. Isolation of virus particles by continuous-flow centrifugation was examined both theoretically and experimentally. A rotor (B-V) capable of sedimenting particles as small as Echo 28 was constructed and successfully tested. Since many viruses are inactivated by pelleting, the possibility of devising a high-speed continuous-flow centrifuge in which the virus particles are sedimented into a density gradient was examined. Two systems (B-VI and B-VII) designed and built during this period showed both the feasibility of this approach and the difficulties to be overcome. On the basis of this work, rotor B-VIII was built and successfully tested. The low-speed A-IX rotor has undergone extensive tests with cell fractions from plant and animal sources, and the high-speed C series rotors were gradually moved from the level of experimental test systems to that of biological experimentation. (auth)

35679 (TID-20976) THE APPLICATION OF GAS-LUBRICATED BEARINGS TO HIGH SPEED TURBOMACHINERY. Quarterly Technical Report, March 1, 1964–May 31, 1964. J. G. Hinkle, E. J. Gunter, Jr., and D. D. Fuller (Franklin Inst. Labs. for Research and Development, Philadelphia). Contract AT(30-1)-2512. 15p. (Q-A2392-3-13)

Information is given on the following steady state characteristics of the self-acting, pivoted-pad, gas-lubricated bearing: thermal stability, hydrodynamic thrust bearing performance, hydrostatic zero-speed lift capabilities, elevated ambient pressure installation, and comparison of solutions based on compressible and incompressible lubricants. (auth)

35680 EFFICIENCIES OF HIGH-FREQUENCY ION-SOURCE OSCILLATORS. Janos Nagy. Magy. Tud. Akad. At. Kut. Int. (Debrecen) Kozlemen, 6: 61-4(May 1964). (In Hungarian)

Investigations were made on the efficiencies of high-frequency oscillators employed in ion sources. By means of a GI7B tube, a high-frequency power of 260 watts with an efficiency of ~50% at a frequency of 82.77 Mc (including the heating power as well) can be achieved. With an OQQ 151/3000 tube employed, the efficiency is ~60%. (auth)

35681 CONSTRUCTION AND OPERATIONS IN THE MANAGEMENT OF A DECONTAMINATION FACILITY AT THE GEESTHACHT RESEARCH REACTOR. H. Hauser (Kernenergieverwertung in Schiffbau und Shiffahrt mbH, Hamburg). p.206-8 of "Atomstrahlung in Medizin und Technik." Munich, Verlag Karl Thiemig KG, 1964. (In German)

The decontamination plant at Geesthacht uses chemical precipitation only for the present, although ion exchangers are planned. The calcium phosphate method combined with an iron hydroxide precipitation is the process used. The results of the first determinations of the decontamination factors obtainable are reported. (J.S.R.)

Heat Transfer and Fluid Flow

35682 (ANL-6807) HEAT AND MASS TRANSFER TO A GAS-FLUIDIZED BED OF SOLID PARTICLES. Edward N. Ziegler (Argonne National Lab., Ill.). Dec. 1963. Contract W-31-109-eng-38. 68p.

The mechanism of heat and mass transfer from an exchange surface to a fluidized bed of solid particles has been studied. The work is subdivided into three interrelated parts. (A) Simultaneous heat and mass transfer experiments from the surface of a sphere are described for comparable situations in a gas stream and a gas-fluidized bed of solid particles. The systems were chosen so that the fluidized particles would have capacity for heat transport but not mass transport. It was found that solid particles in the fluidized state increased heat transfer 10- to 20-fold, whereas mass transfer was increased only $1\frac{1}{2}$ to 2 times. On the basis of the unique property of the particles for heat transport, and assuming analogous heat and mass transfer in the gas phase, it was concluded that in any mechanism of heat transfer in the fluidized state, 80 to 95 percent of the transfer must be accounted for by particle transfer. The remainder may be accounted for in a path solely in the gaseous phase. (B) The results of measurements of heat transfer coefficients from a porous sphere and a cylindrical heater to a bed of solids fluidized in an air stream are presented. The solid particles varied only in their thermal properties. The heat transfer coefficient was found to increase with heat capacity of the solid and was independent of the thermal conductivity of the solid. A model which predicts the observed relation of heat transfer coefficient to the thermal properties of the solid was utilized. This model is based on particle heat absorption and utilizes a statistical distribution of particle residence times. Particle residence times back-calculated from the model agree with residence times observed ex-

perimentally and calculated from simple theoretical models. A maximum Nusselt number of 7.2 is predicted for any fluidized system satisfying the assumptions of the model. (C) The mass transfer data for diffusion from an internal surface to a fluidized bed obtained in the first two parts are analyzed. A correlation based on dimensional analysis accurately predicts Sherwood numbers for transfer from a stationary sphere to a fluidized bed of nonadsorbing particles. A model is proposed to describe the more general case of a bed of adsorbing particles. The model is found to agree with published data in those cases in which adsorption rates are highest. Discrepancies at lower adsorption rates are accounted for. (auth)

35683 (ANL-6835) FREE CONVECTION OF A LOW-PRANDTL-NUMBER FLUID IN CONTACT WITH A UNIFORMLY HEATED VERTICAL PLATE. K. S. Chang, R. G. Akins, L. Burris, Jr., and S. G. Bankoff (Argonne National Lab., Ill.). Jan. 1964. Contract W-31-109-eng-38. 77p.

A first-order perturbation analysis was made of laminar free convection of an incompressible viscous fluid from a uniformly heated vertical plate with both leading and trailing edges. The method is similar to that developed for forced flow past a horizontal flat plate by Kuo, which uses Lighthill's technique of coordinate perturbation, and was later applied by Yang and Jerger to free convection from an isothermal vertical plate. The zeroth-order solution is the exact boundary-layer solution in terms of the similarity variable, η, given by Sparrow and Gregg. New zeroth-order results are presented for Prandtl numbers (Pr) of 0.03 and 0.01, which show that the heating effect is still appreciable even at $\eta = 20$. This makes the iterative process sensitive to the guessed initial conditions. Sparrow and Gregg's solution for Pr = 0.1 was also repeated to obtain the required accuracy for the first-order perturbation. The correction due to the first-order perturbation was then made by matching a boundary limit problem for the boundary layer to an interior limit problem for the external inviscid flow. The first-order vertical velocity was obtained from a sink-strength distribution at the plate for the potential flow, which in turn was based on the horizontal velocity component at the edge of the boundary layer. Although the leading- and trailing-edge singularities are accentuated, it is not necessary to use coordinate perturbation for the first-order corrections that appear as power series in the vertical distance variable, X, with coefficients that are functions of η. For Pr = 0.1 and 0.03, the first ten functions were computed for both the velocity and temperature perturbations. The corrected velocity and temperature profiles were compared with the boundary-layer solution for Pr = 0.1 and 0.03 at $0 < X < 1$, and at modified Grashof numbers (Gr_L^*) of 10^7 and 10^9. As expected, the deviations are more pronounced near the leading edge and at the lower Pr and Gr_L^*. The effect of Gr_L^* in the range from 10^5 to 10^9 was also investigated at the plate midpoint. It was deduced that the boundary-layer solution and the perturbation solution at the plate midpoint coincide asymptotically at $Gr_L^* \sim 10^{10}$ for Pr = 0.1, and at 10^{11} for Pr = 0.03, which conditions are close to the transition to turbulent flow. Extensive numerical results are presented. (auth)

35684 (ANL-6862) TWO-PHASE HEAT TRANSFER WITH GAS INJECTION THROUGH A POROUS BOUNDARY SURFACE. A. A. Kudirka (Argonne National Lab., Ill. and Associated Midwest Universities, Lemont, Ill.). Mar. 1964. Contract W-31-109-eng-38. 120p.

Thesis submitted to Purdue Univ., Lafayette, Ind.

Hydrodynamic aspects of two-phase heat transfer were studied experimentally in a forced-circulation system for the low-quality range. The role and influence of nucleation and convective mechanisms in enhancing heat transfer, the nature of the nucleation mechanism, including the influence of flow pattern, mass velocity, void fraction, and quality on the rate and nature of heat transfer were investigated. These aspects of two-phase heat transfer were studied not with an actual boiling system, but with a two-component system where the hydrodynamic aspects of boiling were simulated by bubbling air through the wall of a porous heated tube into water and by ethylene glycol flowing upward inside the tube at room temperature and atmospheric pressure. The porous tube was $\frac{5}{8}$-in. ID, with an 11-in. long electrically heated section and an 11-in. long unheated section preceding it. Since one objective of this study was to verify experimentally the hydrodynamic similarity between boiling and bubbling of air from a porous surface, comparisons with boiling systems were made. A photographic comparison of bubbling and boiling from identical tubes in a tank of "Freon-11" showed the processes to be similar. Void fractions for air-water flowing in the tube, obtained with the gamma-ray attenuation technique, could be correlated in terms of slip ratio versus volumetric gas/liquid ratio. Heat-transfer results could be correlated better using volumetric gas/liquid ratios than void fractions. Phase distributions with and without gas injection at the walls were different due to influence of gas bubbling, but heat-transfer results could be explained better in terms of local conditions at the heated wall instead of the overall phase distributions in the tube. Correlation of two-phase heat-transfer results with no gas bubbling from the walls showed that dependence of heat-transfer coefficient on mass velocity and volumetric gas/liquid ratio at low qualities was much smaller than is usually associated with higher qualities. The influence of gas-bubbling rate on heat transfer was additive, but algebraically rather than arithmetically as was previously claimed. While the heat-transfer coefficient always increased with increasing bubbling rate for air-ethylene glycol, it sometimes decreased for air-water. A simplified superposition type model based on microconvection, vapor-liquid exchange, and "convection area reduction" mechanisms predicted the trends of bubbling rate on heat transfer satisfactorily. Gas-injection results at low and moderate bubbling rates compared quite well with nucleate pool boiling when convective heat-transfer rates were relatively low. This agreement indicated that the high heat-transfer rates at low and moderate boiling-heat fluxes in circulation as well as pool systems are caused mainly by microconvection and vapor-liquid exchange action of bubbles. Hence, the enhancement in heat transfer is hydrodynamic in nature, making latent heat transport unimportant as a heat-transfer mechanism. For forced-circulation air-water results with gas injection, convection was dominant, and increases in heat-transfer rate with gas addition were mainly due to increased convection rates. Hence, air-water results could not be represented in terms of pool boiling. Examination of various systems indicated that the diameter of air bubbles may be important in determining the influence of air-injection rate. (auth)

35685 (APL-TDR-64-19) LOW-GRAVITY POOL-BOILING HEAT TRANSFER. Robert Glen Clodfelter (Aeronautical Systems Div. Propulsion Lab., Wright-Patterson AFB, Ohio). Jan. 28, 1964. 46p. (AD-437803)

The results are presented of an investigation into the characteristics of pool boiling at reduced gravity. Experimental data taken in a 1.8-second drop tower, using water as the test fluid, are given for a 0.020-inch diameter platinum wire and ⅛-inch and ¼-inch platinum ribbons. In the range of nucleate boiling no significant influence of gravity or geometry was observed, whereas the critical heat flux was affected by both gravity and the geometry of the container, as well as by the time at reduced gravity. (auth)

35686 (BNL-7998) SOME ANALYSES RELATED TO CONVECTIVE BOILING HEAT TRANSFER. J. C. Chen (Brookhaven National Lab., Upton, N. Y.). [1964]. Contract AT-30-2-GEN-16. 14p. (CONF-537-4)

From USAEC-EURATOM Conference on Two Phase Flow Problems, Washington, D. C., Apr.–May 1964.

Analyses are presented for the calculation of (1) effective Reynolds numbers in two-phase flow, (2) bubble growth in nonuniform temperature field, and (3) boundary layer thickness in annular two-phase flow. (D.L.C.)

35687 (COO-774-4) FLUID-SOLID HEAT TRANSFER STUDY. Final Report. Robert S. Brodkey (Ohio State Univ. Research Foundation, Columbus). June 1964. Contract AT(11-1)-774. 10p.

Theoretical and experimental studies are reported of fluid–solid heat transfer in packed beds and fluidized beds. (T.F.H.)

35688 (GEAP-4615(Pt.II)) ANALYSIS OF VARIOUS TYPES OF TWO-PHASE ANNULAR FLOW. PART II. PREDICTION OF TWO-PHASE ANNULAR FLOW WITH LIQUID ENTRAINMENT. S. Levy (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). May 1964. Contract AT(04-3)-189. 37p.

An analytical prediction of two-phase annular flow with liquid entrainment is presented. The solution is obtained by considering the momentum and mass transfer components of the interfacial shear and showing that the momentum term is dominant within the liquid film, while the mass transfer term is the important component within the gas core. An expression is derived for the interfacial shear in terms of liquid film thickness, and this equation is used: (a) To correlate the available CISE film thickness data in circular pipes with two-phase flow of water or alcohol and argon or nitrogen at various pressures. (b) To predict liquid film thickness, liquid film flow rate, and liquid entrainment in the gas core. Typical results are presented for steam–water mixtures flowing in circular pipes at high pressure. (c) To outline a calculational method for more complex geometries such an an annulus. (auth)

35689 (HW-80970(Rev.1)) TWO-PHASE PRESSURE DROP IN PIPING COMPONENTS. D. E. Fitzsimmons (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 20, 1964. Contract AT (45-1)-1350. 60p.

Two-phase and single-phase pressure-drop data were obtained for horizontal 2 in. pipe and piping components that included 90° bends of 2 in., 3 in., and 10 in. radius of curvature; a branch tee; and valves of both gate and globe design. Also studied were sudden expansions and contractions involving 1, 1½, 2, and 3 in. pipe as well as an orifice with an opening equal to 0.8 of the pipe diameter. Data were obtained at mass velocities from 1,000,000 to 4,000,000 $lb_m/(hr)(ft^2)$ in the 2 in. pipe and at steam qualities up to 24% by weight. Most data were obtained at 1200 psia while a selected number of experiments were performed at 800 and 1600 psia. Single-phase pressure-drop data for all components were compared with handbook values. Two-phase pressure-drop data for the straight pipe were compared with values predicted by the homogeneous model, the Martinelli-Nelson correlation, and the Levy momentum exchange model. The two-phase pressure-drop data for the components were compared with the homogeneous model in most cases and were related to the results from the straight pipe. A correlation was developed to relate two-phase to single-phase pressure-drop ratios of the bends to the pressure-drop ratios for the straight pipe over the pressure range of 800 to 1600 psia. (auth)

35690 (NYO-2404-4) EFFECTS OF ELECTRICAL FIELDS ON BOILING HEAT TRANSFER. Quarterly Progress Report, February 4–May 25, 1964. Robert L. Durfee, Charles R. Nichols, and Michael Markels, Jr. (Atlantic Research Nuclear Corp., Alexandria, Va.). Contract AT(30-1)-2404. 54p.

A loop facility for studying the effects of electric fields on boiling heat transfer is described. A-c voltages at 60 cps are found to increase boiling heat transfer and prevent film boiling in deionized water under forced convection near 1 atm. Voltages up to 5 kv are applied, and heat transfers approximately twice as great as the normal nucleate boiling peak are achieved. An analysis of surface wetting during d-c voltage application is carried out for isopropanol and water. In the normal film boiling region, surface wetting initially contributes strongly to the increased heat transfer. At higher voltages, other factors such as local mixing and bubble characteristics appear to predominate. (T.F.H.)

35691 (WCAP-3374-1) SUPERCRITICAL TECHNOLOGY PROGRAM. Quarterly Progress Report No. 1, April–June 1964. W. H. Comtois and W. S. Boyd, eds. (Westinghouse Electric Corp. Atomic Power Div., Pittsburgh). July 1964. Contract AT(30-1)-3374. 72p.

The objectives of this program are to: build and install a supercritical water-cooled in-pile fuel-testing loop; test fuel in a pressure tube to demonstrate the feasibility of collapsed clad elements in a reactor environment, cooled by supercritical water; Evaluate the design of the fuel elements by post-irradiation examination; and evaluate loop performance by analyzing operating data. Two fuel assemblies manufactured by different methods (pellets and vibratory compaction) will be tested. Two clad materials (16 Cr–20 Ni SS and Incoloy 800) will be included in each assembly. The design of the loop is being completed. Fuel assembly design and pressure tube design have been completed and drawings released for manufacture. Components of the pressure tube and fuel assemblies are in process. (auth)

35692 FLOW FIELD IN A SWIRL CHAMBER. D. H. Tsai (Technische Hochschule, Stuttgart). AIAA (Am. Inst. Aeron. Astronaut.) J., 2: 1504-5(Aug. 1964).

The tangential component of the flow velocity, the flow direction, the mass rate of flow, and the total pressure at different axial and radial positions were measured in a series of swirl chambers with different length/diameter ratios. (D.C.W.)

35693 HEAT TRANSFER DURING THE MOVEMENT OF METALLIC SODIUM IN A TUBE. V. M. Borishanskii, T. V. Zablotskaya, and N. I. Ivashchenko. At. Energ. (USSR), 16: 524-6(June 1964). (In Russian)

Experiments were performed at temperatures from 175 to 300°C, flow velocities from 0.6 to 1.5 m/sec. Reynolds numbers from (6 to 120) × 10^3, Pe numbers from 35 to 1000, and in the condition that the wall thermal current was constant. The concentration of oxygen in the sodium varied from 0.02 to 0.1% by weight. Results of heat transfer mea-

surements in the region of thermal stabilization, obtained from observation of the temperature distribution as a function of current cross section, are presented in the form Nu = f(Pe). For Pe in the region 30 to 200, this equation becomes Nu = 4.36 + 0.016 Pe. The variation of the infinite thermal contact resistance with the Pe number is presented for various concentrations of oxygen. Analysis of results from this and previous studies allows, in a first approximation, a characterization of the regions of contact thermal resistance which cause a reduced thermal transfer during flow in the vicinity of the heater. External diffusion, internal diffusion, and intermediate regions are considered. (M.J.T.)

35694 COMBINED RADIATION AND CONVECTION IN AN ASYMMETRICALLY HEATED PARALLEL PLATE FLOW CHANNEL. E. G. Keshock and R. Siegel (Lewis Research Center, Cleveland). J. Heat Transfer, 86: 341-50 (Aug. 1964).

An analysis was made of the effects of radiation exchanges upon the wall-temperature distributions in a parallel plate channel through which a gas transparent to thermal radiation is flowing. A uniform heat flux was applied at one wall, while the other wall had no imposed heat flux and only received energy by radiation or convection from the heated wall. This situation approximated that found in the outer passage of a nuclear reactor fuel element where one channel wall is a fuel plate while the other is the support structure. Axial heat conduction was neglected in the channel walls and the gas, and constant fluid properties were assumed. The effects of a number of independent parameters, such as Stanton number, inlet gas temperature, and length-spacing ratio, are illustrated. (auth)

35695 TRANSIENT HEAT TRANSFER IN THE HETEROGENEOUS WATER REACTOR. [PART] II. Shigenori Hayashi, Akira Sakurai, and Tetsuo Iwazumi (Kyoto Univ.). Nippon Genshiryoku Gakkaishi, 6: 399-405(July 1964). (In Japanese)

By theoretical analysis of SPERT-I step transient tests, studies were made on the relation between the transient heat transfer and the reactor power wave forms, and relation between the transient heat transfer and the flow of the coolant during the power excursions of the long reactor periods. In the power excursions of short reactor periods, the transient boiling heat transfer was also studied. (P.C.H.)

35696 INVESTIGATIONS OF CRITICAL HEAT FLUXES FOR TUBULAR FUEL ELEMENTS IN NUCLEAR POWER PLANTS. B. A. Zenkevich, O. L. Peskov, and V. I. Subbotin. Teploenergetika, No. 6, 20-2(June 1964). (In Russian)

Data are given on critical boiling and steam-water flow in tubes. Verifications are made of calculations on critical heat flux in tubular fuel elements in a nuclear reactor. (R.V.J.)

35697 STEAM FLOW MEASUREMENT BY THE TOTAL-SAMPLE METHOD. B. A. Fries (California Research Corp., Richmond). 10p. (CONF-179-7)

From American Chemical Society Radionuclidic Exchange on Soils, Minerals, and Resins, Philadelphia, April 1964.

Steam flows were measured by the total-sample method using tritium tracer. This method was tested with good accuracy on a 500 psig superheated steam line flowing at 100,000 pounds per hour and on a 130 psig saturated steam line flowing at 10,000 pounds per hour. Tracer water is injected into the steam line; downstream, a very small sidestream is passed through a condenser, and the condensate is collected. The collection time includes the interval during which the tracer wave passes the sampling point. Tritium activity in the water samples is measured with a liquid scintillation counter. The flow rate is computed from the equation: Q = AF/RT; where Q is the steam flow; A is the tritium activity injected; F is the sample counting efficiency; R is the average sample count rate; and T is the time interval over which the sample wss collected. The field equipment is small and light; the time required is less than an hour, and there is no radiation hazard in handling the tracer. Only a few millicuries are required for flows up to 100,000 pounds per hour. (auth)

35698 STEAM GENERATOR MORE ESPECIALLY FOR NUCLEAR POWER INSTALLATIONS. Armin Schopf (to Maschinenbau-Aktiengesellschaft Balcke). British Patent 965,147. July 29, 1964. Filed June 25, 1962.

A steam generator is designed for nuclear power plants having a pressure vessel with a heat exchanger incorporated therein. The exchanger consists of a plurality of parallel heating tubes whose ends are connected in a header or headers formed of double walls, which are welded together only when the welded connections of the tubes with the header have been tested. (D.L.C.)

Materials Testing

Refer also to abstract 36048.

35699 (HW-81956) THIN-WALL TUBING TESTS USING ULTRASONIC SHEAR WAVES. PART I. THEORY OF ULTRASONIC WAVE PROPAGATION, EXPERIMENTAL DATA, AND NOTCH FABRICATION. M. F. Zeutschel and N. E. Dixon (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). June 12, 1964. Contract AT(45-1)-1350. 45p.

Hanford-developed broadband narrow beam ultrasonic equipment and inspection techniques are described. This equipment generates shear waves for testing thin wall tubing or plates. A description of shear waves and their relationships to more complex Lamb waves is presented. Also presented are notch depth versus signal amplitude curves obtained at a variety of ultrasonic incident angles. These curves demonstrate the test sensitivity, capability, and limitations in tubes ranging from 12 to 65 mils in wall thicknesses of aluminum, Zircaloy, and stainless steel. Defects down to 1 mil in depth by 15 mils in length are reliably detected while notches of increasing depth are detected with continuously increasing signal amplitudes. Identical test results are obtained by propagating shear waves around the circumference of the tube to detect axial defects and by propagating shear waves down the axis of the tube to detect circumferential defects. A $\frac{3}{16}$ in. diameter crystal, fitted with a $\frac{1}{4}$ in. radius of curvature spherical focusing lens, provides an ultrasonic beam focused to 8 mils in effective diameter for the test. Variations in this beam diameter or beam symmetry are measured along with other ultrasonic transducer variables such as frequency and damping. These transducer measurements are then related back to the notch depth versus amplitude curves. Methods of manufacturing ultrasonic standards in the tubing to be tested are also discussed. A simple punch system was developed and used for obtaining the data in this report. By instrumenting the punch with a differential indicator, notches are economically and accurately punched into the tubing. Results from the entire research and development program are tabulated for quick reference. These data establish recommended procedures for a variety of tubing

test applications and outline results that may be expected from each. (auth)

35700 (NAA-SR-Memo-8162(Rev.)) AN IMPROVED METHOD OF SHOCK TESTING ON SHAKERS. R. M. Oliva (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Apr. 4, 1963. Contract [AT(11-1)-Gen-8]. 10p.

A highly successful method for performing ½ sine shock testing on shakers was devised. It represents a considerable improvement over other methods. The shaker output is a relatively clean wave exhibiting little over-shoot or ringing. To date the method employed has been reproducible on a Calidyne Model 246 shaker (upright or coupled with a slip plate) and on a Calidyne Model 249 shaker (upright or coupled with a slip plate) with a wide range of specimen weights. Shock pulses of 1 to 40 g, 1 to 12 millisec duration, are easily attained. (auth)

35701 (ORNL-TM-888) FEASIBILITY OF ULTRASONIC DETECTION OF NONBOND IN ATR FUEL PLATES. K. V. Cook and R. W. McClung (Oak Ridge National Lab., Tenn.). Aug. 1964. Contract W-7405-eng-26. 11p.

A feasibility study was made to detect conditions of nonbond between type 6061 aluminum cladding and 34 wt % U_3O_8–Al dispersion cores in the ATR roll-clad fuel plates. Discussion is presented on the ultrasonic through-transmission technique, which was selected to monitor the bonding quality. The capabilities and limitations of this method as well as the significant results and conclusions that have evolved in this study are described. General conclusions are based mainly on results obtained in the evaluation of the 0.050-in.-thick (0.015-in. clad–0.020-in. core–0.015-in. clad) fuel plates, which are representative of the latest fabrication practices. (auth)

Protective Structures

35702 (NP-14108) EMERGENCY OPERATING CENTERS. Professional Guide Series. Interim Edition. (Praeger-Kavanagh-Waterbury, Engineers-Architects, New York). Jan. 1964. Contract OCD-OS-62-57. 119p. (PG-80-7)

Emergency operating centers are intended to serve as protected facilities to provide for the command and control function of political jurisdictions from which responsible officials can command and control emergency operations during and after a nuclear attack. Data are presented for the guidance of architects engaged in the design of protective structures either as separate underground structures or incorporated into the basement of public or office buildings. Topics discussed include site selection; structural factors; blast closures and protective systems; heating, ventilation, and air conditioning; plumbing; emergency power sources; communications centers; and methods used for ground shock testing. (C.H.)

GEOLOGY AND MINERALOGY

General

Refer also to abstract 35903.

35703 (BRL-1237) A MACHINE PROGRAM FOR COMPUTING NONLINEAR VISCOELASTIC WAVE PROPAGATION IN SOILS. Millicent M. Beck (Ballistic Research Labs., Aberdeen Proving Ground, Md.). Jan. 1964. 47p. (AD-438168)

A numerical method and its machine program for calculating nonlinear viscoelastic wave propagation in soils are described. Solutions give particle velocity, stress, and strain as functions of time and distance from the stress source. (auth)

35704 (TEI-849) GEOLOGIC MAP OF SCRUGHAM PEAK QUADRANGLE, NYE COUNTY, NEVADA. F. M. Byers, Jr., and David Cummings (Geological Survey, Washington, D. C.). Aug. 1964. 25p.

The map describes the following geological features of the Scrugham Peak Quadrangle: alluvium, colluvium, basalt of Buckboard Mesa, basalt dike, volcanic fan gravel, Thirsty Canyon tuff, air-fall and ash-flow tuff, Piapi Canyon Formation, colluvium and debris flows, rhyolite of Caldrea Moat, and rhyolite in south-facing cliff on Pahute Mesa. (D.L.C.)

35705 (TID-7695(p.181-94)) SEISMIC WAVE PROPAGATION. W. V. Mickey (Coast and Geodetic Survey, Washington, D. C.).

The Coast and Geodetic Survey has recorded and analyzed over 6000 seismic data channels from seismograph recordings at distance ranges of less than 0.5 to over 350 km, in conjunction with the current nuclear detonation program starting in September 1961. Prediction functions for transitory earth motion in terms of displacement, velocity, and acceleration have been developed for yield ranges of less than 0.05 to 200 kt. Vibration perceptibility thresholds from biophysical sources are reviewed with particular application to seismology. Calculations of percentage of total source energy conversion to seismic energy is evaluated over the yield range of 0.43 to 200 kt for several different media. The relative seismic energy for contained and cratering nuclear detonations are presented. Seismic propagation characteristics for several events are studied. (auth)

35706 (TID-7695(p.195-206)) SEISMIC AMPLITUDES AT AN INTERMEDIATE RANGE FROM EXPLOSIONS. Dorris M. Hankins (Sandia Lab., Albuquerque, N. Mex.).

Short-period seismic waves from the Nevada Test Site shots have been recorded by Sandia Laboratory's four-station seismic net during the past $2\frac{1}{2}$ years. Epicentral distances vary from 130 to 240 kilometers. Raw maximum wave amplitudes usually vary as the yield to the 0.8 to 1 power. The medium in which the detonation takes place influences the magnitude of the seismic signals. Shots in dry alluvium produce the smallest seismic signals, while those in granite give the largest signals observed. Both the P-phase amplitude and its ratio to the S-and-surface-phase amplitude vary notably with travel path. (auth)

35707 (TID-7695(p.229-38)) PROGRESS AND PROMISE IN THE STUDY OF THE EARTH USING NUCLEAR EXPLOSIVES. Carl Romney and Wayne Helterbran (Air Force Technical Applications Center, Washington, D. C.).

A review of measurements of seismic waves from nuclear explosions has shown a number of results which have implications of interest for basic studies of the earth. Among these are observations which show regional differences in travel times and amplitudes which have been interpreted in terms of structural differences, and variations in travel times and amplitudes at teleseismic ranges which suggest inhomogeneities in the mantle. Comparisons between explosion- and earthquake-generated waves have given new information on the nature of earthquake sources. A number of suggestions are made on methods for further study of fundamental problems by means of large explosions. (auth)

35708 INERT GASES OF STONY METEORITES. A. P. Vinogradov and I. K. Zadorozhnii (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Moscow). Geokhimiya, No. 7, 587-600(July 1964). (In Russian)

The content and isotopic composition of He, Ne, and Ar was investigated in 21 chondrites, three carbonaceous chondrites and one achondrite. Most of the stony meteorites contain three components of inert gases: primary, cosmogenic and radiogenic. The variations of the isotopic composition of cosmogenic gases in chondrites are in the main determined by the changes of the energy spectrum of cosmic radiation and to a lesser degree by variations of the chemical composition. The cosmogenic ^{38}Ar content correlates with the Ca content in achondrites. The radiation age of stony meteorites varies from 1 to 120×10^6 years. The U–Th–He and K–Ar age changes in the ranges from 0.5 to 4.5×10^9 years. Considerable differences between the U–Th–He and K–Ar ages are, however observed, chiefly towards lesser values of U–Th–He ages. This may be explained by the loss of a considerable part of He after meteorite formation. (auth)

35709 THE AGE AND THE THERMAL HISTORY OF STONY METEORITES AND MINERALS. L. K. Levskii (Lab. of Geology, Leningrad). Geokhimiya, No. 7, 601-9 (July 1964). (In Russian)

The spectrum of age values of stony meteorites is explained by various losses of radiogenic gases caused by thermal excitation of the crystal lattice. The analysis is carried out in terms of annealing the disturbances in crystals. Equations are suggested, the solution of which gives the true age of meteoritic matter, the true cosmic age and the excitation temperature. Some variants of thermal effects are considered. For terrestrial rocks and minerals, an analogous model may be used. The given equations lead to the true age of minerals and the parameters of thermal impulse (metamorphism). Possible ways of determining the parameters of the crystal lattice of minerals are considered. (auth)

35710 ABSOLUTE GEOCHRONOLOGY OF THE SOUTHERN AND CENTRAL AREAS OF THE YENISEI MOUNTAIN RANGE. E. K. Gerling and Yu. M. Artemov (Lab. of Geology, Leningrad). Geokhimiya, No. 7, 610-22(July 1964). (In Russian)

From data obtained with the U–Th–Pb, K–Ar, and Rb–Sr methods of absolute age determination for the southern and central parts of the Yenisei mountain range, six stages of magnetism and related phenomena in the interval of 255 to 260×10^6 yr are identified. It is established that the most authentic age values for rocks subjected to later metamorphic processes are given by the

Rb–Sr method. A greater conformity of the Rb–Sr results with data of other methods is obtained using the disintegration constant of 1.47×10^{-11} yr for ^{87}Rb. It is also noted that the primary ($^{87}Sr/^{86}Sr$) ratio for granitoids of the area changes during the last 2500 million years by 1 to 2%. (auth)

35711 ON THE NATURAL CORRECTION OF ZIRCON STRUCTURE DISTORTIONS CAUSED BY RADIATION AND ITS GEOLOGICAL SIGNIFICANCE. B. A. Yunikov and L. N. Ovchinnikov (Inst. of Geology, Academy of Sciences, USSR). Geokhimiya, No. 7, 623-34(July 1964). (In Russian)

Fifty zircons from various regions of the Ural, Kazakhstan, the Ukraine, and New England were studied. It was established that parallel with the destruction of the lattice structure of zircon, a reverse process of structure renewal (natural annealing) occurs. This renewal depends on the intensity of metamorphism and the temperature effect which the given sample experienced every day. It was established that the annealing intensity (λ) has a linear dependence on the intensity of alpha radiation (A): $\lambda = C \cdot A$. The zircon samples regularly combine into six groups. For various zircon groups, the course of the linear dependence of the annealing intensity on radiation intensity is essentially different. The value C, remaining constant within the group, changes strongly for different groups. The analysis of the conditions for discovering the zircons shows that such a combination into groups reflects the similarity and difference of the thermodynamical conditions of their existence. (auth)

35712 RARE-EARTH ELEMENTS IN SCHEELITES OF THE URAL. P. V. Pokrovskii (Inst. of Geology, Sverdlovsk, USSR). Geokhimiya, No. 7, 646-9(July 1964). (In Russian)

Scheelites from scheelite- and gold-scheelite deposits of the Ural differ strongly in content and composition of rare earth elements, which may serve as a geochemical criterion for determining the absolute age of separate scheelite deposits. (auth)

35713 RADIOGEOLOGY OF SOME HIGH-BACKGROUND AREAS OF BRAZIL. F. X. Roser, G. Kegel, and T. L. Cullen (Catholic Univ., Rio de Janeiro). p.855-72 of "The Natural Radiation Environment." Chicago, University of Chicago Press, 1964.

The geotectonic features of Brazil are described. The different types of radioactive ore deposits that can be found are outlined. A geological survey was conducted on regions with radiation intensity levels at least several times above normal background: monazite sand deposits and volcanic intrusives. (D.L.C.)

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Refer also to abstracts 35260 and 35762.

35714 (BNL-7329) RARE GAS ISOTOPE CONTENTS IN MINERAL FRACTIONS OF THE INDARCH METEORITE. E. L. Fireman (Brookhaven National Lab., Upton, N. Y. and Smithsonian Astrophysical Observatory, Cambridge, Mass.) and O. A. Schaeffer (Brookhaven National Lab., Upton, N. Y.). [1962]. Contract [AT(30-2)-Gen-16]. 5p.

Isotopic measurements were made on He, Ne, Ar, and Kr contents in Indarch meteorite fractions of differing specific gravity. The tabulated results show that: ^{40}Ar is concentrated in the sp gr 2.4 to 2.8 fraction. The ^{4}He content is uniform. A large part of the cosmogenic ^{3}He and ^{21}Ne has been lost by diffusion from the tridymite and the 2.4 to 2.8 fractions. The cosmogenic ^{38}Ar is highest in the 2.4 to 2.8 fraction and is probably produced by cosmic ray reactions with K and Ca. The Kr is concentrated in the tridymite fraction. The ^{129}Xe anomaly is highest in the enstatite fraction and lowest in the tridymite fraction. (D.L.C.)

35715 (DASA-1307) PROJECT STAR DUST. Seventh Quarterly Report. James P. Friend, Herbert W. Feely, and Micah W. M. Leo (Isotopes, Inc., Westwood, N. J.). Feb. 1, 1963. Contract DA-49-146-XZ-079. 40p. (AD-432153)

Current versions of the Star Dust model of atmospheric mixing and circulation have duplicated satisfactorily the observed behavior of tungsten-185 injected into the tropical stratosphere during mid-1958. The rate of deposition on the earth's surface and the latitudinal distribution of the deposit were reproduced adequately. The rate of decrease of the maximum concentration in the stratosphere and the rate of lateral movement of the point at which one half this maximum concentration is reached were also duplicated. Thus far, however, the models are unable to reproduce the observed poleward slope of the level of maximum concentration. Gamma spectra of samples collected during January 1963 show the presence of antimony-124 in fresh debris, which must have been produced during the December 1962 Soviet tests. Very large quantities of nuclear debris were injected into the stratosphere of the northern hemisphere by the late 1962 Soviet test series. The stratospheric burden of strontium-90, as calculated from the distribution of that nuclide in the Star Dust sampling corridor, increased from approximately 2.0 megacuries during January-April 1962 (with about 1.2 megacuries attributed to the 1961 Soviet test series) to perhaps 3.3 megacuries during May-August 1962 (with approximately 1.5 megacuries attributed to the 1962 United States test series). By the end of 1962 the burden had increased to approximately 6.4 megacuries as a result of the 1962 Soviet test series. Measurements of products of neutron activation indicate stratospheric burdens during May-August 1962 (corrected for decay to 15 October 1961) of approximately 40 megacuries of manganese-54, 63 megacuries of iron-55, 2 megacuries of cobalt-57, 135 megacuries of antimony-124, and 0.05 megacuries of thallium-204. Carbon-14 concentrations in ground-level air in northern New Jersey decreased during the winter of 1962-1963 although the strontium-90 concentrations in precipitation increased, perhaps as a result of the late 1962 Soviet tests. (auth)

35716 (IA-888) THE COMPOSITION OF RADIOACTIVE FALLOUT DURING THE 1962/1963 RAINY SEASON IN ISRAEL. J. R. Gat and N. Passy (Israel. Atomic Energy Commission. Soreq Research Establishment, Rehovoth). Nov. 1963. 15p.

The origin of radioactive fallout in air and rain in Israel from August 1962 to June 1963 was established by radiochemical analysis and meteorological data. Large amounts of pre-1962 fallout were present late in the winter and during the spring of 1963, while the early winter fallout resulted almost exclusively from the 1962 test series. Average stratospheric residence half-time for debris from the 1961 autumn test was calculated to be 2.3 years. Fallout from the larger tests seemed to appear with a delay of at least one year. Evidence for tropospheric fallout, which appeared about 3 months after some nuclear tests, is presented. (auth)

35717 (TID-7695(p.139-52)) FALLOUT CALCULATIONS AND MEASUREMENT. M. M. Williamson (Corps of Engineers).

A general discussion of fallout and the definition of various terms peculiar to any discussion of fallout problems are presented. Sources of radioactivity and types of radiological hazards as they pertain to nuclear excavation are also discussed. An outline is presented of the steps which might be taken in the preshot planning and postshot evaluation of fallout problems as applied to a nuclear excavation project. The preshot planning phase includes a discussion of the data necessary for fallout prediction, fallout prediction techniques, and interpretation of the fallout prediction in terms of on-site and off-site radiological safety. The postshot phase includes a discussion of some of the data which must be collected after firing, how these data may be collected, and how the data are used for fallout pattern construction and other calculations necessary to evaluate radiological hazards. Also included is the interpretation of the fallout pattern to determine re-entry times, actual on-site and off-site radiological hazards, and the fraction of the total activity vented as prompt fallout. (auth)

35718 ON SOME PHYSICAL CHARACTERISTICS OF HOT ALPHA-ACTIVE AEROSOL PARTICLES. B. I. Styro, E. Yu. Vebra, and K. K. Shopauskas. At. Energ. (USSR), 16: 528-30(June 1964). (In Russian)

Aerosol tests using membrane filters were carried out in the spring of 1963 in the Vil'nyus region at heights of 0 to 3 km. More than 20 α-active particles were found. The filters were exposed in photoemulsions for varying lengths of time in order to study the accumulation of α tracks, to deduce histograms for the investigation of particle composition, and to determine the approximate particle size. It was concluded that α-active aerosol particles do not contain significant quantities of β and γ emitters and are different from ordinary hot particles. The energy spectrum was estimated from the lengths of tracks in the emulsions to identify the α emitters. Energy spectrum histograms of the emitters are compared with those from a natural radioactive aerosol. Some properties of the α-active particles are presented: the height at which they were collected, their activities, and their diameters, measured and calculated from the α emission of ^{235}U and of ^{239}Pu. It is concluded that the particles are dissimilar and consist of isotopes such as ^{235}U, ^{238}U, ^{232}Th, and ^{239}Pu. (M.J.T.)

35719 HOT AIRBORNE PARTICLES IN SURFACE AIR NEAR MOSCOW. S. G. Malakhov and K. P. Makhon'ko. At. Energ. (USSR), 16: 530-3(June 1964). (In Russian)

Results of systematic measurements of the concentration of global fallout with activity from 10^{-13} to 10^{-8} C/particle in ground-level air are presented. About 1200 m^3 of air were drawn through a FPP-15 filter every day from Sept. 1961 to Dec. 1962 near Moscow. All the particles were divided into three groups according to size. The average monthly concentrations of hot aerosol particles, the concentration in each size group, and the average activity/particle are given. To obtain a more detailed picture of the particle distribution according to size and β activity, the β activity of five size groups was measured for May to July and Sept. to Oct. 1962, using an end-window counter. Half lives of the separated hot particles and of the entire samples are compared for selected days in 1962. (M.J.T.)

35720 EASILY MEASURED RADIOACTIVE FALLOUT. L. Van Middlesworth (Univ. of Tennessee, Memphis). Health Phys., 10: 508(July 1964).

It is pointed out that a simple Geiger-Muller counter gives good performance for the detection of radioactive fallout on the ground. Results obtained every 100 to 150 miles along the roadside between Memphis, Tenn. and Hanford, Wash. during June 1963 using a battery operated Victoreen survey meter and an Al Geiger tube with walls 30 mg/cm^2 are reported. Maximum readings were obtained by placing the detector in contact with old vegetation on the ground. The ground was then scraped to a depth of 1 to 2 cm and the radiation measured in the cleaned spot. The radiation from unscraped ground or vegetation was usually 6 to 10 times greater than that measured after the surface was scraped. The same monitor performed well at an altitude of 33,000 ft. (C.H.)

35721 LONG-LIFE RADIOACTIVITY IN OCCASIONAL THYROIDS. L. Van Middlesworth (Univ. of Tennessee, Memphis). Nature, 203: 199-200(July 11, 1964).

Radioactivities in cattle thyroid glands from Colombia, Japan, and the United States are reported. Specimens were screened for radioactivity by a single-channel pulse height analyzer that accumulated the 0.3 to 0.4 Mev γ radiation. Repeated measurements on samples containing the most activity showed no detectable reduction after two to four months, indicating that the radioactive source was not ^{131}I. Three types of long-life radioactivity in thyroids are reported: two of them are tentatively identified as ^{137}Cs and ^{226}Ra, the third is still unidentified. Gamma spectra of thyroids from the three countries are compared. (H.M.G.)

35722 DIFFUSION OF Ce^{144} IN SOIL. V. M. Prokhorov and Tien-ying Chai. Pochvovedenie, No. 7, 107-8(1963). (In Russian)

The relation between the diffusion coefficient of ^{144}Ce and moisture was investigated for a light loamy soil. It was revealed that the relation is not linear, ^{144}Ce diffuses much slower than ^{90}Sr and ^{137}Cs due to a high degree of adsorption and a low mobility of adsorbed ions. (auth)

35723 PROFILE OF NATURAL RADIOACTIVITY IN HARTSELLS LOAM. J. D. Burton, W. B. Guenther, and H. M. Owen. Soil Sci. Soc. Am. Proc., 28: 500-1(July-Aug. 1964).

During the summer of 1961 bulk samples at 4-in. to 30-in. depth increments were collected at 15 random locations within an apparently uniform single acre of Hartsells loam in an oak-hickory timber stand on the Cumberland Plateau in Tennessee. Net radioactivity, total potassium content, and mechanical fractions were determined in the laboratory. After samples were stored in sealed containers for 7 days, activity was counted again and found to be increased. Linear regressions of initial activity on silt-plus-clay and on K, K on silt-plus-clay, and 7-day activity on clay, on K, and on 1-day activity were highly significant. Distributions of K, and of initial activity in the soil profile were more closely related to the profile of total fines than to the clay curve. Initial activity was believed to be due largely to ^{40}K, but activity gain during storage was probably due to daughters of ^{238}U. (auth)

35724 FACTORS AFFECTING Sr^{85} AND I^{131} REMOVAL BY RUNOFF WATER. E. R. Graham (Univ. of Missouri, Columbia). Water Sewage Works, 110: 407-10(Nov. 1963).

The effects of soil cover crop and the amount of rainfall on the amount of ^{85}Sr and ^{131}I removed by runoff water were studied. The percentage of added ^{85}Sr removed as runoff and erosion from a fallow plot was 0.097% for the fall of 1960 and 0.982% for the fall of 1961. When a plot was covered with wheat stubble, this was reduced to 0.026% for the fall of 1960 and 0.037% for the fall of 1961. The percentage removed from plots covered with corn stubble was intermediate. The ^{131}I removed from a fallow plot was 0.438% for the fall of 1961 and 0.004% for the fall of 1962.

The ^{131}I removed from a plot covered with fescue was 0.003% in the fall of 1961 and zero in the fall of 1962. When rain fell at low rates (less than 0.2 in/hr) or stopped before significant amounts had fallen, the plots used in this study held the rainwater and the radioactivity. (Publ. Health Eng. Abstr.)

35725 THE DISPERSION OF RADIONUCLIDES IN OPEN CHANNEL FLOW. Calvin Clyde Patterson. Thesis, Austin, Tex., Univ. of Texas, 1963. 107p.

The Colorado River and the Pierce Ranch Canal were selected as test reaches. The fluorescent organic dyes, Rhodamine B and Fluorescein, were chosen as tracers and detection was accomplished with a Turner model 111 fluorometer. Tracer releases were made instantaneously at midstream. Longitudinal dispersion was measured in both the Colorado River and the Pierce Canal, and transverse dispersion was measured in the Colorado River. Successful sampling was accomplished with portable continuous flow equipment operated in a small aluminum boat. Instantaneous injection was approximated with an injector operated with compressed nitrogen. Equations were derived, which made possible the calculation of the true longitudinal (D_x) and transverse (D_y) dispersion coefficients with concentration-time data obtained from two-dimensional tracer plumes. A comparison of D_x calculated with Thomas' dispersion equation was made with measured values of D_x. The calculated coefficient was within the scatter of the measured coefficients. An empirical dispersion coefficient formula, $D_x = 0.8e^{0.034U\sqrt{A}}$ was derived from data obtained in four different channels, where A is the cross-sectional area of the channel. Dispersion coefficients measured were: $D_x = 14.4$ ft^2/sec, Colorado River; $D_x = 1.14$ ft^2/sec, Pierce Canal; and $D_y = 0.55$ ft^2/sec, Colorado River. The data collected in seven longitudinal tests and two transverse tests are presented in summary tables and recorder strip charts. (Dissertation Abstr., 24: No. 12, Pt. I (June 1964))

35726 TRANSPORT OF STRONTIUM AND CESIUM BY STREAM AND ESTUARINE SEDIMENTS. Tom Davidson Reynolds. Thesis, Austin, Tex., Univ. of Texas, 1963. 135p.

Factors involved in the transport of radiostrontium and radiocesium by suspended and bottom sediments frequently found in fresh water streams, lakes, and brackish waters were investigated. An evaluation of the distribution coefficients and mass action constants for these two radionuclides is based on the observed data. In support of these basic studies, uptake and release data were collected for a series of other radionuclides. Laboratory and field studies showed that the concentrations of radiostrontium and radiocesium in the sediment and water were represented by mass action equations. Also, equilibrium computations and radiochemical analyses showed that the concentrations of these two radionuclides in the sediments were fairly uniform throughout the fresh water section of the Guadalupe River although the river passed through various geologic formations. As the ionic concentration increased in the lower reaches of the Guadalupe River, there was a notable change in the distribution of radiostrontium and radiocesium between the sediment and the water. As the river water mixed with the brackish San Antonio Bay water some of the radionuclides were transferred from the sediments and suspensoids to the saline water. It was also shown that sediments present in marine waters sorbed less strontium and cesium than sediments in fresh water. The amount of radionuclide release which occurred when fresh water sediments were deposited in marine water was dependent upon the particular radionuclide under consideration. The distribution of strontium-90 and radiocesium in the lake sediments was dependent upon the grain size. The smaller the grain size the greater the radionuclide content. (Dissertation Abstr., 24: No. 12, Pt. I (June 1964))

35727 THE NATURAL RADIATION ENVIRONMENT. John A. S. Adams and Wayne M. Lowder, eds. A Volume in the Rice University Semicentennial Series. Chicago, University of Chicago Press, 1964. 1080p. $15.00. (CONF-136)

A total of 61 papers are presented on varied topics relevant to the subject of natural radiation. The topics include radioactivity in the earth, radioactivity in water, radioactivity in the atmosphere, alpha radioactivity, cosmic radiation, instrumentation and techniques, aerial surveys, ground measurements and surveys, etc. Separate abstracts were prepared for 46 of the papers. For abstracts of the remaining 15 papers, see NSA 17: 30790, 32314, 32280, 31984, 32459, 30773, 32264, 25604, 27706, 32312, 31829, 18321, 30774, 41135, and 18: 4081. (D.L.C.)

For abstracts of individual papers see: 35271, 35382, 35383, 35405, 35441, 35487, 35713, 35728, 35729, 35730, 35731, 35732, 35733, 35734, 35735, 35736, 35737, 35738, 35739, 35740, 35741, 35742, 35743, 35744, 35745, 35746, 35747, 35748, 35749, 35750, 35751, 35752, 35753, 35754, 35887, 35888, 35889, 35890, 35891, 35892, 36072, 36073, 36074, 36075, 36219, and 36220.

35728 THE COLORADO FRONT RANGE, COLORADO, U.S.A., AS A URANIUM AND THORIUM PROVINCE. George Phair and David Gottefried (Geological Survey, Washington, D. C.). p.7-38 of "The Natural Radiation Environment." Chicago, University of Chicago Press, 1964.

The Colorado Front Range includes the largest and most Th-rich areas of true granite in U. S. Geographic patterns of U and Th distribution in the Range are presented for possible use in mining Th or in studies of background radiation. The petrogenetics, geology, petrology, and geochemistry are discussed. (D.L.C.)

35729 THORIUM, URANIUM, AND POTASSIUM IN THE CONWAY GRANITE, NEW HAMPSHIRE, U.S.A. K. A. Richardson (Rice Univ., Houston, Tex.). p.39-50 of "The Natural Radiation Environment." Chicago, University of Chicago Press, 1964.

An area of high natural radioactivity is located in the Conway granite. The occurrence of Th, U, and K in the rocks of the area was determined. The sites of α emitters in the granite were studied autoradiographically, and the Th and U concentrations in the accessory minerals of the granite are given. (D.L.C.)

35730 STATISTICAL TESTS OF THE HOMOGENEITY OF THE RADIOACTIVE COMPONENTS OF GRANITIC ROCKS. J. J. W. Rogers (Rice Univ., Houston, Tex.). p.51-62 of "The Natural Radiation Environment." Chicago, University of Chicago Press, 1964.

The problem of the distribution of Th and U in the granites of U. S. is approached from the point of view of homogeneity of the contents. After a definition of homogeneity and its detection, the following granite groups are discussed: Paleozoic granites of New England, Nevadan-Laramide granites of the Cordilleran area, and Precambrian granites of central and western U. S. The data show that: the New England granites are rich in Th and U in comparison with Nevadan-Laramide granites. The Precambrian granites have an unusually high Th/U ratio due

to a low U content. The Th/U ratio of the New England granites may be slightly higher than that of Nevadan-Laramide granites. (D.L.C.)

35731 URANIUM, THORIUM, AND POTASSIUM CONTENTS IN BASIC ROCKS AND THEIR BEARING ON THE NATURE OF THE UPPER MANTLE. K. S. Heier (Australian National Univ., Canberra) and James L. Carter. p.63-85 of "The Natural Radiation Environment." Chicago, University of Chicago Press, 1964.

Correlationships of the Th, U, and K contents are discussed for the following basic rocks: basalts, amphibolites, basic intrusives, and eclogites. The concentrations in the upper mantle are small, and the Th/U ratios are expected to be low; the concentrations and ratio increase downward until the primitive mantle material is reached. Data on Th and U contents in basic ultrabasic rocks are tabulated. (D.L.C.)

35732 THE THORIUM, URANIUM, AND POTASSIUM CONTENTS OF ATLANTIC AND GULF COAST BEACH SANDS. Azizeh Mahdavi (Rice Univ., Houston, Tex.). p.87-114 of "The Natural Radiation Environment." Chicago, University of Chicago Press, 1964.

Using 81 field stations and 91 laboratory samples, gamma spectrometric measurements were made on the Th, U, and K contents in beach sands from the Atlantic and Gulf Coasts. The field measurements showed that the contents could be determined to less than 10%. The results show that: Th above 1-2 ppm and U above 0.3-0.6 ppm are contained in dense resistate minerals. Most beaches have a Th/U ratio of 2.5 to 3, with only two beaches (Galveston Island and Cape Cod) having a ratio near the crustal average of 3.8. The contents in several cases can be related to provenance and beach processes. Calculated Th and U contents of sands defined geochemically are too high compared with the experimental data. (D.L.C.)

35733 DETECTION OF NATURAL γ RADIATION IN PETROLEUM EXPLORATION BOREHOLES. C. W. Johnstone (Schlumberger Well Surveying Corp., Houston, Tex.). p.115-27 of "The Natural Radiation Environment." Chicago, University of Chicago Press, 1964.

A discussion is presented of gamma-ray logging of well boreholes. The instrumentation and its development is described, and the logging variables are outlined. Qualitative and quantitative interpretation of the gamma-ray logs is discussed. The problem of calibration is considered. Finally, spectral logging is discussed. (D.L.C.)

35734 AUTORADIOGRAPHIC INVESTIGATIONS OF NATURALLY OCCURRING MATERIALS. Paul C. Ragland (Univ. of North Carolina, Chapel Hill). p.129-51 of "The Natural Radiation Environment." Chicago, University of Chicago Press, 1964.

A review is presented of the use of autoradiography in determining the distribution of α emitters (Th and U) in common rocks. The investigations that used the autoradiographic method are discussed, and some of the data are given. Possible applications of autoradiography are considered. (D.L.C.)

35735 THE DISTRIBUTION OF THE HEAVY RADIOELEMENTS IN THE ROCKS AND WATERS OF FLORIDA. J. K. Osmond (Florida State Univ., Tallahassee). p.153-9 of "The Natural Radiation Environment." Chicago, University of Chicago Press, 1964.

The anomaly of low Th and U contents in sedimentary rocks as compared with igneous rocks is discussed. A program was initiated to study the distribution of the heavy radioelements in the sedimentary rocks and waters of Florida. Alpha pulse-height analysis was used, and some preliminary data are given on the distribution of Th and U in the sedimentary rocks. An attempt was made to calculate the average Th and U contents in Florida rocks; they were found to be very sensitive to the estimated abundance of phosphorite beds and black sands. Data are also presented on the Th, U, ^{224}Ra, and ^{226}Ra contents of several surface and underground waters. (D.L.C.)

35736 RADON MIGRATION IN THE GROUND: A REVIEW. Allan B. Tanner (Geological Survey, Washington, D. C.). p.161-90 of "The Natural Radiation Environment." Chicago, University of Chicago Press, 1964.

A review is presented of the factors that determine the distance that radon isotopes may migrate in the ground. Migration into rock pores, into a porous medium, in unsaturated undisturbed and disturbed rock and soil, and in saturated rock and soil is considered. Migration distances for radon-222 are summarized. The contribution to environmental radioactivity is discussed. Geophysical applications of radon migration are considered. An extensive bibliography is given. (D.L.C.)

35737 MEASUREMENTS OF THE EFFECTS OF ATMOSPHERIC VARIABLES ON RADON-222 FLUX AND SOIL-GAS CONCENTRATIONS. Hobart W. Kraner, Gerald L. Schroeder, and Robley D. Evans (Massachusetts Inst. of Tech., Cambridge). p.191-215 of "The Natural Radiation Environment." Chicago, University of Chicago Press, 1964.

Studies were made on the effects of barometric pressure changes, precipitation, wind, and thermal atmospheric instability on the radon-222 flux at the earth-air interface and on the radon-222 concentrations in the soil gas. The studies were conducted in the glacial debris at Lincoln, Mass., and in weathered tuff and alluvium at Nevada Test Site. The results show that: The atmosphere acts as a piston forcing radon-222-free air into the soil (rising pressure) or pulling radon-222-rich air from the soil (falling pressure). Precipitation causes a "capping effect," reducing the vertical porosity of the surface layers for radon-222 transport. High wind speeds produces a depletion of radon-222 concentrations in soil gas. Atmospheric instability increases the flux by convection. One-dimensional diffusion equations were fitted to the data for alluvium. (D.L.C.)

35738 LEAD-210 (RaD) AND POLONIUM-210 (RaF) IN POTABLE WATERS IN ILLINOIS. Richard B. Holtzman (Argonne National Lab., Ill.). p.227-37 of "The Natural Radiation Environment." Chicago, University of Chicago Press, 1964.

A study of the ^{210}Pb and ^{210}Po concentrations in potable well and surface waters in Illinois was conducted in order to estimate the contribution of the water to the ^{210}Pb and ^{210}Po contents of the human body. ^{226}Ra was also measured, and a correction was made for the ^{222}Rn retention of the containers. The ^{210}Pb contents were unusually low, and it is concluded that potable water is not an important source of ^{210}Pb in the human skeleton. (D.L.C.)

35739 PHYSICAL AND CHEMICAL CONTROLS ON DISTRIBUTION OF RADIUM-226 AND RADON-222 IN GROUND WATER NEAR GREAT SALT LAKE, UTAH. Allan B. Tanner (Geological Survey, Washington, D. C.). p.253-76 of "The Natural Radiation Environment." Chicago, University of Chicago Press, 1964.

A study was made on the behavior of ^{226}Ra and ^{222}Rn in irrigation or stock wells. Various mechanisms of ^{226}Ra and ^{222}Rn control in ground water are discussed. The results

show that the ^{222}Rn content in the water is dependent on the ^{226}Ra content in the sediments in the immediate vicinity of each well, that ^{226}Ra in the sediments is derived locally from ^{230}Th, and that ^{222}Rn anomalies are due to ^{226}Ra migration and immobilization. (D.L.C.)

35740 MEASUREMENT OF γ-EMITTING RADIONUCLIDES IN SOIL AND CALCULATION OF THE DOSE ARISING THEREFROM. Philip F. Gustafson and Sarmukh S. Brar (Argonne National Lab., Ill.). p.499-512 of "The Natural Radiation Environment." Chicago, University of Chicago Press, 1964.

A description is given of a method using γ-ray spectrometry of soil cores to determine natural and fission-product radioactivity present. The techniques used to identify the radionuclides are described. A specific soil sample analysis is presented to illustrate the techniques. Air-dose rates were calculated and found to exceed measured doses by 10 to 20%. (D.L.C.)

35741 FIELD SPECTROMETRIC INVESTIGATIONS OF ENVIRONMENTAL RADIATION IN THE U.S.A. Wayne M. Lowder, William J. Condon, and Harold L. Beck (Atomic Energy Commission, New York). p.597-616 of "The Natural Radiation Environment." Chicago, University of Chicago Press, 1964.

Gamma spectrometric techniques were developed for determining the dose contributions of the individual components of the terrestrial γ radiation field. The scintillation counter is located 1 meter above the ground. Some results are given of a survey carried out in western U. S. in late 1962. (D.L.C.)

35742 THE AERIAL RADIOLOGICAL MEASURING SURVEYS (ARMS) PROGRAM. Robert B. Guillou (Edgerton, Germeshausen and Grier, Inc., Santa Barbara, Calif.). p.705-21 of "The Natural Radiation Environment." Chicago, University of Chicago Press, 1964.

A description is presented of the ARMS program from the natural radiation environment standpoint. The history, instrumentation, and conduct of the surveys are discussed. The compilation of the data and their possible uses are described. (D.L.C.)

35743 AERORADIOACTIVITY SURVEYS AND GEOLOGIC MAPPING. James A. Pitkin, Sherman K. Neuschel, and Robert G. Bates (Geological Survey, Washington, D. C.). p.723-36 of "The Natural Radiation Environment." Chicago, University of Chicago Press, 1964.

The ARMS I program and the equipment used in the aerial surveying are described. The correlation of the aeroradioactivity data with areal geology is discussed in some detail. (D.L.C.)

35744 SOME AERIAL OBSERVATIONS ON THE TERRESTRIAL COMPONENT OF ENVIRONMENTAL γ RADIATION. R. M. Maxham (Geological Survey, Washington, D. C.). p.737-46 of "The Natural Radiation Environment." Chicago, University of Chicago Press, 1964.

The relation between radioelement content and lithologic character of common rocks is discussed. The problems of determining the radioelement distribution are illustrated using an aeroradiometric survey of the southeast Texas Coastal Plain made in 1956. The correlation of the aeroradiometric patterns with geologic and soil patterns is discussed. The analysis of soil samples for U, Th, and K are given, and calculations of equivalent U content are made. Graphs of equivalent U content and surface radiation intensity vs the net aeroradiation intensity are plotted. The radiometric profile of the Coastal Plain is discussed. The results show that the older rocks have a more heterogeneous radioelement distribution and a higher radioactivity level than the younger sediments. (D.L.C.)

35745 ATMOSPHERIC ATTENUATION OF γ RADIATION. A. E. Purvis (Univ. of Dallas) and R. S. Foote. p.747-56 of "The Natural Radiation Environment." Chicago, University of Chicago Press, 1964.

The effects of the atmosphere on the γ-ray spectrum of the earth were studied. The changes in the spectrum with elevation were calculated from theoretical considerations for photopeaks of ^{208}Tl, ^{214}Bi, ^{40}K, and $^{95}Zr-^{95}Nb$. The theoretical changes are compared with experimental results for elevations up to 500 ft. The disparities between theory and experiment are discussed. (D.L.C.)

35746 TIME VARIATION OF TERRESTRIAL γ RADIATION. Robert S. Foote (Texas Instruments, Inc., Dallas). p.757-66 of "The Natural Radiation Environment." Chicago, University of Chicago Press, 1964.

In the study of the time variation of terrestrial gamma spectra, data are being taken every 47 min and analyzed for individual radioisotopes. The major difference between observations is the large decay of ^{140}La. The time variations of ^{214}Bi, ^{208}Tl, $^{144}Ce-^{144}Pr$, ^{40}K, and $^{95}Zr-^{95}Nb$ are discussed. (D.L.C.)

35747 STUDIES OF ENVIRONMENTAL RADIATION AT A PARTICULAR SITE WITH A STATIC γ-RAY MONITOR. P. R. J. Burch, J. C. Duggleby, B. Oldroyd, and F. W. Spiers (Univ. of Leeds, Eng.). p-767-79 of "The Natural Radiation Environment." Chicago, University of Chicago Press, 1964.

A large static background monitor was developed for studying the time variation of the natural γ-ray intensity over long periods of time. The monitor consists of four large disk ionization chambers mounted on top of one another; the chambers measure respectively the γ radiation from the sky, the cosmic rays, and the cosmic rays + γ rays from the ground. Some results of measurements in 1961 and 1962 are given which show the effects of water content of the soil and nuclear weapons testing. (D.L.C.)

35748 EXTERNAL RADIATION LEVELS IN HIGH-BACKGROUND REGIONS OF BRAZIL. F. X. Roser and T. L. Cullen (Catholic Univ., Rio de Janeiro). p.825-36 of "The Natural Radiation Environment." Chicago, University of Chicago Press, 1964.

Results are summarized of field trips that were made on the region of monazite sands along the Atlantic Coast and on the zone of volcanic alkaline intrusives in the states of Minas Gerais and Goias. The measurements included readings made inside buildings, on beaches, etc. Population exposure levels were calculated. (D.L.C.)

35749 ENVIRONMENTAL RADIATION SURVEILLANCE IN THE ANTARCTIC. R. L. Busdiecker and B. W. Maxwell (Public Health Service, Washington, D. C.). p.873-83 of "The Natural Radiation Environment." Chicago, University of Chicago Press, 1964.

Environmental background measurements were conducted on air, snow, and camp water samples at McMurdo and Byrd Stations. Results are given for α, β, radon-222, and radon-220 activities from Jan. 1961 to Jan. 1963. Trends in the data are discussed. (D.L.C.)

35750 ENVIRONMENTAL γ-RAY DOSE TO POPULATIONS: SURVEYS MADE WITH A PORTABLE METER. F. W. Spiers, M. J. McHugh, and D. B. Appleby (Univ. of Leeds, Eng.). p.885-905 of "The Natural Radiation Environment." Chicago, University of Chicago Press, 1964.

A high-pressure ionization chamber was developed. Calibration and testing of the instrument are considered, and

its application to the determination of average dose to populations in Britain is described. Results of surveys are given for Edinburgh, Dundee, Aberdeen, and Aberdeenshire. (D.L.C.)

35751 ENVIRONMENTAL RADIATION SURVEY IN NORTHERN NEW ENGLAND. Wayne M. Lowder (Atomic Energy Commission, New York), Ascher Segall, and William J. Condon. p.907-17 of "The Natural Radiation Environment." Chicago, University of Chicago Press, 1964.

The results of four surveys on population exposure to natural radiation in Maine, New Hampshire, and Vermont are summarized. These surveys are a radiogeological survey of bedrock radioactivity, environmental radiation measurements both outdoors and inside private homes, a personnel monitoring survey, and a survey of the ^{226}Ra, ^{224}Ra, and ^{210}Po in teeth from long-time residents. The results show a narrow range of radiation exposure. No correlation was found between cancer and congenital malformation incidence and bedrock radioactivity, and data on the latter cannot be used to calculate population exposure. (D.L.C.)

35752 ENVIRONMENTAL NATURAL RADIOACTIVITY MEASUREMENTS AT TROMBAY ESTABLISHMENT. P. R. Kamath, A. A. Khan, S. R. Rao, T. N. V. Pillai, M. L. Borkar, and S. Ganapathy (Atomic Energy Establishment, Trombay, India). p.957-78 of "The Natural Radiation Environment." Chicago, University of Chicago Press, 1964.

Background radiation measurements have been carried out in four areas: Trombay Establishment, Jadugoda Mines, monazite sands, and Udaisagar Mines. The results are summarized, and some radiochemical methods which were used are described. Background buildup near nuclear facilities and waste release is considered. Radioactivities of the following materials were studied: foodstuffs, soils, water, biological samples, and vegetation. (D.L.C.)

35753 DETERMINING THE CONTRIBUTION OF γ RAYS TO THE NATURAL ENVIRONMENTAL RADIATION AT GROUND LEVEL. M. Geyh and S. Lorch (Niedersächisches Landesamt für Bodenforschung, Hanover). p.979-88 of "The Natural Radiation Environment." Chicago, University of Chicago Press, 1964.

Results are summarized of measurements carried out over several years in Western Germany. Measurements were made on open terrain (scintillation counter mounted on jeep) and also in and around buildings. The effects of towns, plant growth, and precipitation on the readings are discussed. (D.L.C.)

35754 ENVIRONMENTAL RADIOACTIVITY SURVEYS IN SPAIN. Eduardo Ramos and Margarita Celma (Nuclear Energy Board, Ministry of Industry, University City, Madrid). p.989-1010 of "The Natural Radiation Environment." Chicago, University of Chicago Press, 1964.

The plan of the environmental radioactivity survey established by the Board of Nuclear Energy is described, and the results are summarized. The measurements included radioactivity and radioisotopes in air, atmospheric dusts, water, soils, milk, vegetation, and bone. (D.L.C.)

Site Survey and Selection

35755 GEOLOGY AND HYDROLOGY OF THE WESTERN NEW YORK NUCLEAR SERVICE CENTER. John G. Broughton and Herbert G. Stewart. 9p. (CONF-498-6)

From Geological Society of America 1963 Annual Meeting, New York, Nov. 1964.

Geologic and hydrologic studies were made on the Western New York Nuclear Service Center, which is now being developed for the reprocessing of spent nuclear fuel elements and the storage or disposal of high, intermediate, and low level radioactive wastes. Geologic considerations played a vital part in the site selection and development. (P.C.H.)

Techniques and Equipment

35756 CALCULATION OF ERRORS IN ABSOLUTE METHODS OF DETERMINING GEOLOGICAL TIMES. II. CALCULATION OF ERRORS IN THE POTASSIUM–ARGON METHOD. Adam Kovach. Magy. Tud. Akad. At. Kut. Int. (Debrecen) Kozlemen, 6: 35-49(May 1964). (In Hungarian)

By aid of Gauss's error law, a relation was established between relative errors of age values obtained by the potassium–argon method and the errors of measurement arising during the actual application of the method (errors in the quantitative determinations of ^{40}Ar and ^{40}K) as well as errors due to the incertainty of constants applied (partial decay constants and isotopic abundance of ^{40}K). The expressions and nomograms can be used for calculation of the probable error of age determination at given measuring errors. (auth)

35757 PROBLEMY YADERNOI GEOFIZIKI. (Problems of Nuclear Geophysics). A. I. Kholin, ed. Moscow, Publishing House on Mineral Resources, 1964. 215p.

Available and prospective nuclear methods for prospecting and exploration are reviewed as well as theoretical problems in physical and mathematical modeling. The Mössbauer effect, the method of delayed coincidences, γ-ray capture spectrometry, and improvements of radiometric equipment are considered, and the efficiency and economics of nuclear geophysics are analyzed. (R.V.J.)

HEALTH AND SAFETY

Refer also to abstracts 35260, 35476, 35831, 36222, and 36827.

35758 (AD-431930) BULGUR WAFER AND ADJUNCTS FOR FALLOUT SHELTER RATIONS. Period Covered: July 1962–June 1963. (Department of Agriculture. Western Regional Research Lab., Albany, Calif.). Dec. 1963. 80p.

Long-term (5-year) studies of the storage life of bulgur wheat survival wafers and adjuncts (foods to serve with the wafers to vary fallout shelter menus) are in progress. In order to shorten the time required to obtain estimates of storage stability, methods to speed deterioration are being investigated. Chemical-physical analyses are being made in a search for an objective test that correlates with organoleptic evaluation. Components of the vapors from rancid bulgur have been isolated by use of gas-liquid chromatography; some components may be useful indicators of incipient rancidity. Natural antioxidants in wheat have been found to disappear early in the bulgur-making process. Tests of various bulgur-puffing techniques have been made and are reported, including processing effects on texture of the bulgur. Wafers formulated with materials reputed to alleviate radiation effects have been tested, and some flavoring additives have been tried. Fifty-eight adjuncts have been developed and evaluated. A plastic bag for mixing and dispensing adjuncts has been designed for use in the shelters. (auth)

35759 (AD-432345) RADIOLOGICAL MONITORING STUDY. A. L. Baietti and Al Zirkes (Tracerlab. Inc. Western Div., Richmond, Calif.). Nov. 15, 1963. Contract OCD-OS-62-151. 251p.

Radiological monitoring systems for use following a nuclear attack are reviewed. A system is recommended that uses a combination of flash reports for the preparation of fallout contour maps, unshielded land vehicles for transportation, and monitoring on foot. The major advantages of this combination are low cost, simplicity, and low personnel exposure. The Appendix gives proposed procedures for applying scaling factors and plotting a number of selected contours. (C.H.)

35760 (HW-67245(Rev.)) HANFORD WHOLE-BODY COUNTER RESULTS FOR 1960. F. Swanberg, Jr. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). June 1, 1961. Contract AT(45-1)-1350. 28p.

Results are reported from the whole-body counting of 1,004 individuals during 1960. The largest amounts of radioactive materials found in any subject were 15.3 nc of ^{137}Cs, 10.0 nc of ^{24}Na, and 92.0 nc of ^{65}Zn. These quantities are equivalent to 0.05, 0.14, and 0.15%, respectively, of the recommended maximum permissible body burdens for occupational exposure. (C.H.)

35761 (HW-79279) PRELIMINARY MEASUREMENTS OF THE ADSORPTION OF REACTOR EFFLUENT WATER RADIONUCLIDES BY COLUMBIA RIVER PARTICULATE MATERIAL. L. L. Humphreys and R. W. Perkins (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Oct. 16, 1963. Contract AT(45-1)-1350. 10p.

Laboratory experiments showed that dilution of reactor effluent water ten fold with river water resulted in a rapid adsorption of several of the soluble radionuclides on the river water particulates. Between 25 and 40% of the soluble radionuclides adsorbed during a 24-hr period were adsorbed during the first minute of contact. Data are presented on the adsorption of ^{56}Mn, ^{24}Na, ^{239}Np, ^{140}La, ^{64}Cu, ^{51}Cr, ^{46}Sc, and ^{65}Zn by the inorganic and organic detritus and microorganisms in Columbia River water. (C.H.)

35762 (NAVDOCKS-MO-218) RADIOACTIVITY IN WATER SUPPLY AND WASTE WATER SYSTEMS: PEACETIME DETECTION AND CONTROL. (Bureau of Yards and Docks). Oct. 1962. 80p.

Discussion is presented on: the causes and characteristics of radioactivity; biological effects of radiation; allowable concentrations of radioisotopes; methods of determining nuclide concentrations and removing radioisotopes; the detection, analysis, and monitoring of radioactivity in water supplies and wastes; personnel protection through safety precautions in plant operations; and the authority and responsibility of the bureaus of the Navy Department and the field activities concerned. Practical procedures for determining the gross alpha and gross beta radioactivity of water, soil, and biological samples are appended. (P.C.H.)

35763 (NP-14161) SURVEY OF INTERSTATE POLLUTION OF THE ANIMAS RIVER (COLORADO-NEW MEXICO). E. C. Tsivoglou, S. D. Shearer, R. M. Shaw, Jr., J. D. Jones, J. B. Anderson, C. E. Sponagle, and D. A. Clark (Robert A. Taft Sanitary Engineering Center, Cincinnati). May 1959. 123p.

The Animas River from Durango, Colorado, to Farmington, New Mexico, a distance of some 60 river miles, serves as a source of water supply for several communities, is used in the raw state as a water supply for some 2,000 persons, is used for recreational purposes, including swimming and fishing, provides water for the irrigation of some 26,000 acres of cropland, provides water for livestock, is the source of industrial process water for a uranium ore refinery, and carries away the wastes from this mill as well as wastes from the city of Durango and other small sources. Data are presented from studies of pollution problems of the River. Measurements were made of the extent of radioactive, chemical, organic, and bacteriological pollution, and the effects of pollution on existing legitimate uses of the interstate waters. The internal radiation exposure due to Ra and ^{90}Sr was evaluated in the Durango-Farmington population area, and an estimate was made of the portion of this exposure that resulted from Ra and other waste discharges from the Vanadium Corp. of America uranium refinery at Durango, Colo. (C.H.)

35764 (NP-14207) A PROTOTYPE MANUAL FOR PLANNING, ANALYZING AND SCHEDULING FOR RADIOLOGICAL EXPOSURE. Mario V. Cammarano (Curtiss-Wright Corp. Curtiss Div., Caldwell, N. J.). May 1964. Contract OCD-OS-62-279. 45p.

A planning strategy designed for use during the post-attack phase of a nuclear attack is presented. The report also presents the planning assumptions and techniques specifically expressed in the Second Edition of A Prototype Civil Defense Manual for Radiological Decontamination of Municipalities prepared for the Office of Civil Defense. Included is a description of the post-attack picture and a discussion of the characteristics of the radiation field with respect to time after detonation and distance from ground zero. The mathematical basis for, and operation of a dose accumulation analyzer are presented. The analyzer is designed to yield fast, accurate information on the probable

dose accumulation in personnel resulting from any desired exposure schedule. Data concerning area entry time, minimum shelter stay time, optimum starting times for work crews, optimum evacuation time, and decontamination feasibility, for any combination of standard dose rate and residual number, effective fallout arrival time, and any allowed dose criterion can easily be obtained from the analyzer. (auth)

35765 (ORNL-P-199) GRADUATE PROGRAMS FOR THE HEALTH PHYSICIST IN THE UNITED STATES. Karl Z. Morgan (Oak Ridge National Lab., Tenn.). [July 24, 1964]. Contract [W-7405-eng-26]. 40p. (CONF-642-1)

From Health Physics Society, Cincinnati, June 1964.

The history of training programs in the field of health physics in the U. S. is reviewed with emphasis on education and training programs at Oak Ridge National Lab. Graduate programs for training health physicists are reviewed as of July 1964. The role of the U. S. Atomic Energy Commission, the Oak Ridge Institute of Nuclear Studies, and the U. S. Public Health Service in supporting graduate programs and reviewing applications is discussed. (C.H.)

35766 (ORNL-TM-923) TRU GLOVE BOX FIRE TEST RESULTS. T. S. Mackey (Oak Ridge National Lab., Tenn.). Aug. 14, 1964. Contract W-7405-eng-26. 9p.

Fire tests conducted in the proposed Transuranium glove box demonstrated the necessity for promptly extinguishing the fire to prevent containment loss due to possible burn through of the rubber gloves and to prevent heat buildup in the glove box floor which in each test produced an explosive mixture due to the increased evaporation rate of the solvent. Explosion tests demonstrated the necessity for prevention of explosive concentrations in the glove box since the ignition of an ortho-xylene air mixture just inside the explosive range produced pressure sufficient to rupture the box seals. From the results of the tests of fire extinguishing system components, it was concluded that the optimum protection system would consist of a standard commercially available water spray nozzle with a small reservoir containing 2- to 3-gal of water under a reliable pressure force such as a spring or dead weight. (auth)

35767 (SC-R-64-127) MEASUREMENTS FROM GRAVEL GERTIE TESTS. Maynard Cowan (Sandia Corp., Albuquerque, N. Mex.). July 1964. Contract AT(29-1)-789. 40p.

Results of the second Nevada test of the AEC's special structure ("Gravel Gertie") indicate that plutonium fallout within 3000 feet of a burst within the structure is reduced to $\frac{1}{4}$ the amount for a similar detonation in the open, when the burst occurs with the access door to the structure open. Contamination levels higher than 100 $\mu g/m^2$ caused by detonation of 550 pounds of high explosive could extend over one mile from the structure under the same conditions. Tracer material (uranium) used in the test escaped through the open entrance. Standard operating procedure for this structure calls for the door to be closed. Results of the third NTS test of the structure are summarized. They indicate that no external plutonium contamination would result from the detonation of 550 pounds of high explosive with uranium as a tracer material within the main room when the entrance is closed by a blastproof door. (auth)

35768 (TID-7695(p.127-38)) DISTRIBUTION IN GROUNDWATER OF RADIONUCLIDES FROM UNDERGROUND NUCLEAR EXPLOSIONS. Frank W. Stead (Geological Survey, Denver).

Radionuclides released from underground nuclear explosions in the Plowshare Program will be initially distributed in the medium by direct explosive action; long-lived and biologically significant radionuclides may later enter into and move with groundwater flow. Where adequate precautions have been taken, as at the Nevada Test Site and at other sites such as Plowshare Project Gnome, or significant postexplosion movement of radionuclides can as yet yet be demonstrated; however, radioactive waste disposal operations clearly indicate that radionuclides can be transported considerable distances by groundwater flow. A single, universally applicable prediction of the character and extent of possible radionuclide contamination of groundwater is precluded by the complex interrelationship and variability of the environmental factors; thus, each proposed site of a Plowshare nuclear explosive application must be carefully evaluated, to determine if unique geologic and hydrologic conditions are present which might permit relatively rapid and prolonged migration of radionuclides. (auth)

35769 (TID-7695(p.161-8)) HAZARDS TO MAN FROM RADIOACTIVITY. John W. Gofman (California. Univ., Livermore. Lawrence Radiation Lab.).

Potential biological hazards, directly to man or indirectly to man or indirectly via bisopheric members involved in man's food chains, represent a major consideration in engineering applications of nuclear explosives. Indeed it is possible that the biological problems presented are more difficult of solution than will be many of the technical engineering problems. Production of a variety of radioactivities is an inevitable concomitant of the utilization of nuclear explosives. To some extent there is an element of choice based upon nuclear explosive design as to which chemical elements are represented among the radioactivities produced. Development work may enable reduction in production of certain radioactivities, but it is unlikely that order-of-magnitude reductions can be achieved easily. Therefore, it is a matter of great moment to have realistic guidelines concerning potential biological hazards so that the engineering problem can be evaluated. This discussion considers the basis for whatever guidelines currently exist, the uncertainties involved, and the kinds of information that are required if such guidelines are to be made more definitive. (auth)

35770 (TID-19416) IODINE-131 IN BOVINE THYROID GLANDS FROM 1957 THROUGH 1961. Clifton Blincoe, V. R. Bohman (Nevada. Univ., Reno); and E. L. Fountain (Nevada Operations Office, AEC). [1962]. Contract [AT(04-3)-509]. 29p.

The thyroid ^{131}I concentrations in Nevada range cattle at three locations and in Reno slaughter cattle were studied from late 1957 to the resumption of nuclear weapons tests in September 1961. A marked gradient in thyroid ^{131}I concentration occurred with distance from reactor tests and nuclear weapons tests of low and high yield. A constant, small (1 pc/g) concentration of ^{131}I was observed in bovine thyroid glands in the presence of all reported releases of ^{131}I to the atmosphere. It was concluded that range cattle are very efficient monitors of the ^{131}I in the biosphere. (auth)

35771 (TO-B-63-76) THE EFFECT OF LIMITED STRIPS OF CONTAMINATION ON THE DOSE RATE IN A MULTISTORY, WINDOWLESS STRUCTURE WITH 40-PSF WALLS AND 50-PSF FLOORS. Albert W. Starbird (Technical Operations Research, Burlington, Mass.). Oct. 15, 1963. Contract OCD-OS-62-14. 82p. (AD-434787)

The effects of limited rectangular fields of contamina-

tion on the dose rates within multistory structures were evaluated for a structure with 40 psf walls and 50 psf floors. Comparisons were made between experimentally determined results and those obtained through use of the OCD Guide for Architects and Engineers, the National Shelter Survey Computer Program, and the OCD manual entitled, The Design and Review of Structures for Protection from Fallout Gamma Radiation. Recommended experimentally obtained multiplicative correction factors for accounting for limited strips of contamination are presented. Good agreement was obtained between experimentally measured and computed infinite-field above ground dose rates and for basement rates at a 5-ft to 6-ft depth only. Basement measured dose rates were higher than computed values at greater depths. (auth)

35772 (UCLA-12-529(p.69-84)) ENVIRONMENTAL RADIATION. (California. Univ., Los Angeles. School of Medicine. Lab. of Nuclear Medicine and Radiation Biology).

Environmental radiation monitoring activities at selected locations of the Nevada Test Site are summarized. Data are reported on the effects of fallout fission products and cratering on the ecology of plant and small animal populations, food-chain fission product kinetics, and radiation effects on vegetation and animal populations. Data are included from a study of the effects of γ radiation on lizard and frog populations of a Puerto Rican forest. (C.H.)

35773 (UCRL-7811) HAZARDS CONTROL QUARTERLY REPORT NO. 16, JANUARY–MARCH 1964. (California. Univ., Livermore. Lawrence Radiation Lab.). Contract W-7405-eng-48. 46p.

Preliminary data are given concerning dosimetric sensitivity, energy dependence, and reproducibility of pure LiF doped with europium and magnesium. Luminescent dosimeter materials have been developed with more favorable energy dependence characteristics than strontium sulfide. A simple model for estimating damage is discussed and tentative "safe" levels of 10^{-7} joule and 10^{-6} watt for pulsed and continuous lasers, respectively, are given for laser radiation entering the eye. Portable battery-operated "Hi-Volume" air samplers operate for 30 minutes before recharging is necessary. Radioiodine sampling tube losses depend more on transport velocity than on the tube material used. A system for ventilation of soldering and acid dip tank operations has been applied. A method is described for decontaminating surfaces of contaminating surfaces of contaminated platinum metal. Laboratory tests of five commercial brands of surgeon-type gloves indicate that quality is not commensurate with cost. (auth)

35774 (USACDCNG-62-5(Rev.)) FALLOUT FROM MULTIPLE SURFACE BURSTS. (Army Combat Developments Command. Nuclear Group, Fort Bliss, Tex.). May 1964. 79p.

The effects of receiving fallout from more than one source on decay and total dose calculations and predictions are discussed. The adaptability of the current Army fallout prediction system to the multiple surface burst fallout situation is examined. Simple procedures for the estimation of cumulative radiation dose are suggested for use in field situations. (C.H.)

35775 (WAPD-TM-348) A FORTRAN PROGRAM FOR THE CALCULATION OF THE POTENTIAL HAZARDS FROM AN ACCIDENTAL FISSION-PRODUCT RELEASE — MO142. R. J. Eckert (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). July 1964. Contract AT(11-1)-Gen-14. 24p.

A FORTRAN program (MO142) was written to facilitate the evaluation of biological hazards derived from an atmospheric release of radioactive nuclides. The program provides a convenient and economical method to perform a detailed analysis of the space and time-dependent radiation doses resulting from a potential fission-product release incident. By employing the same model, consistent comparisons can be made of the relative consequences associated with different types of fission-product release, regardless of whether they occur in the same reactor plant or in different reactor installations. Sensitivity of the results to any one variable can be easily ascertained by treating that variable as a parameter in a series of calculations. The program is sufficiently flexible in that it permits the calculation of the hazards from any radioactive source of known concentration and isotopic distribution. The nuclides which form the radioactive cloud are specified as program input. For each nuclide, an initial concentration, release rate, radioactive decay constant, and average γ and β emission energy must also be supplied. In addition, the exposure period, the distance from the source to the receptor point, and the appropriate meteorological conditions must be specified. For each nuclide in the calculation, the program computes the external γ and β dose and the inhalation dose to several critical organs. The total in each category is obtained by a straightforward summation of the individual nuclide doses. (auth)

35776 (AEC-tr-6458) STRONTIUM-90 IN THE WATER OF THE DON RIVER BASIN. V. B. Stradomskii. Translated from a publication of the State Committee on the Peaceful Uses of Atomic Energy, SSSR, Moscow, 1963. 5p.

The content of radiostrontium in the water of the Don River basin, which is widely used for various everyday needs, in particular as a drinking-water supply for a large number of population points, was studied. Data are presented characterizing the contamination of the water with ^{90}Sr during the period of time from June 1961 to August 1962. The ^{90}Sr content in samples of Don water was 0.7-0.9 pC/l in Aug.-Sept. 1961. In Nov. it had increased by approximately 50%. During the ice-covered period, it decreased somewhat to 0.9-1 pC/l, rose during the period of passage of the thaw waters, and then gradually decreased. (P.C.H.)

35777 (NP-tr-1161) DIRECTIVE REVISING ANNEXES 1 AND 3 OF DIRECTIVES FIXING THE BASIC STANDARDS OF HEALTH PROTECTION, AND DIRECTIVE ON FREE ENTRY TO QUALIFIED POSTS IN THE NUCLEAR FIELD. Translated by L. C. Hickman (U.K.A.E.A., Atomic Energy Research Establishment, Harwell, Berks, Eng.), from J. Officiel Communautés Européennes, 5: No. 57, 1962. 34p.

Recent revisions in directives of the Council of the European Atomic Energy Community concerning basic standards of radiation protection for the population and workers in the atomic energy industry are reviewed. The directive concerning the free movement of qualified workers with specific training and education within the European Atomic Energy Community is also reviewed. A list of qualifications for employment in various positions is appended. (C.H.)

35778 PROTECTION OF RESPIRATORY TRACT IN AN ATOMIC CENTER. J. Rodier, J. Chassany, and G. G. Langlet. Arch. Maladies Profess., Med. Travail Securite Sociale, 24: 787-802(1963).

With the progress made in industrial techniques, new

dangers have arisen for the workers. Parallel with this development, departments studying and applying means of protection have developed and increased their range of action. The newborn atomic industry, more than any other industry, is aware of these problems and preoccupied with ways and means of solving them. In the atomic industry, it is the danger of atmospheric contamination that offers the greatest difficulties as to protection. Atmospheric control based on one or several radioactive aerosol registrators gives no absolute safety. In larger works, the air is controlled only at certain selected points, which are not perfectly representative of the immense spaces in which air currents move under the influence of natural and artificial draughts and changes in temperature. The sampling point is of great importance, and measurements below the CMA do not necessarily mean that the wearing of an apparatus to protect the respiratory tract is superfluous. Each case and each type of work requires a separate study. The risk is the greater because air movements and changes in working conditions during the same operation may at any moment pose the problem of noxious atmosphere as a result of resuspension of precipitated radioactive particles. Numerous factors enter into the highly complex and therefore inaccurate evaluation of risks; to be taken into account are the useful effect of filters, measuring apparatus, the nature of the radiation from radioactive elements, their energy and the nature and diameter of particles. Numerous theoretical studies of protection against radiation were made; from a practical point of view, however, the experience so far has been limited and haphazard. Only by systematic examination of results obtained will be possible to acquire a knowledge of safety margins. Meanwhile, in the Marcoule Center, on the basis of results of spectrographic examination of workers and radiotoxicological analyses made by the Medical Department, it may be said that the difficulties of working in a radioactive environment have been overcome. The present system governing the use of respirators has made possible access to and work in areas entailing a rise of contamination, under very satisfactory conditions of safety. (Excerpta Med., Sect. 23, 1: No. 7, July 1964)

35779 ABSORPTION AND MEASUREMENT OF RADIONUCLIDES IN WOUNDS AND ABRASIONS. G. B. Schofield. Clin. Radiol., 15: 50-4(1964).

Some of the problems concerning contaminated wounds are discussed. Unfortunately, there is not enough evidence available to enable accurate prognostications to be made regarding the absorption and ultimate fate of radionuclides deposited in wounds. Some sort of pattern has emerged. A high peak immediately after the accident is followed by a lower level of absorption for some considerable time. A clearer picture could be obtained if a large series of contaminated wounds could be collected and adequately followed up for a longer period of time. The question of treatment was considered, particularly in regard to its shortcomings. The methods used are generally effective but caution must be exercised in deciding whether α-contaminated wounds are adequately dealt with, as instrumental readings are not always reliable, since the degree of shielding of the contaminant is not known. As the rate and quantity of uptake of a radionuclide is unknown, it is highly important that daily urine samples should be taken for a period of time after the event. Excision of the wound by no means guarantees that it will be clear of contamination. The review suggests two lines of research which could be especially useful: there should be more experimental work, both on humans and animals, particularly with reference to the local physiological and pathological effects which influence absorption and translocation of foreign material; more accurate methods of urinalysis, together with the use of the whole body monitor, could be combined with a closer follow-up of actual cases of contaminated wounds. (Excerpta Med., Sect. 23, 1: No. 7, July 1964)

35780 ENVIRONMENTAL RADIOACTIVITY AND FOODS. K. G. Bergner (Chemische Landesuntersuchungsanstalt, Stuttgart). Deut. Apotheker-Ztg., 103: 551-6 (1963). (In German)

The sources of the environmental radioactivity are briefly indicated and the biological cycle of radioisotopes is illustrated. The permissible limits for ^{90}Sr, ^{131}I, ^{137}Cs, and ^{89}Sr unofficially set up in the German Republic are listed. The establishment of stations to monitor the radioactivity in foods is described and a brief review is given of the measurement methods used. (J.S.R.)

35781 REPORT ON EXECUTION OF ENVIRONMENTAL RADIOACTIVITY SUPERVISION. K. G. Bergner and P. Jaegerhuber (Chemische Landesuntersuchungsanstalt, Stuttgart). Deut. Lebensm.-Rundschau, Nos. 2 and 3, 42-6; 78-85(Feb.-Mar. 1963). (In German)

The origin of environmental radioactivity and the basis of evaluation for the environmental radioactivity are reviewed. Monitoring procedures are described that are used in the German Federal Republic. The types of measurements made, methods used for selection of the food samples, sampling techniques, and types of samples taken are described. The measurement devices used in the chemistry and isotopic monitoring laboratories are considered. (J.S.R.)

35782 LIMITATION OF QUANTITY OF RADIOACTIVE SUBSTANCES MANIPULATED OR TRANSPORTED. EVALUATION OF ACCIDENTAL RADIATION EXPOSURES. F. Duhamel and J. M. Lavie (Centre d'Études Nucléaires, Saclay, France). Health Phys., 10: 453-68(July 1964). (In French)

Various national and international groups have studied the problem of limiting the quantities of radioactive substances which may be manipulated under certain operating conditions. The most valuable studies have been achieved on the basis of radiobiology. Now, it is clear that the results from radiobiology do not suffice to establish a complete and scientific basis. For practical application, numerous complementary hypotheses must be made. In attempting to interrelate operations which are very different, the authors propose a procedure which, although not scientifically rigorous, makes apparent the relationships being hypothecated between the fundamental theoretical assumptions and the practical values to be observed. This procedure permits one to evaluate, unambiguously, the maximum quantities to be manipulated in the case of any radionuclide, chemical form, physical state, degree of containment, type of operation, kind of facility and technical skill of the operators. Thus this procedure possesses great flexibility and permits one to determine these quantities on a scale extending over a range of 10^{14}. (auth)

35783 INCIDENCE AND POSSIBLE SIGNIFICANCE OF INHALED OR INGESTED POLONIUM. Ernest Marsden. Nature, 203: 230-3(July 18, 1964).

Experimental evidence on the role of polonium in cancer initiation at various sites, including the lung, and on its relation to certain possibly induced genetic changes is presented. Two widespread probable sources of inspired polonium are identified as: inhaled tobacco smoke and the exhaust of automobile gasoline when lead compounds are used for enhancement of octane rating. Tobacco plants

were grown in a greenhouse in large pots using either low-activity soil as control or soil enriched with various finely ground uranium ores and monazite. Although monazite itself was not readily taken up, the uptake of uranium and thorium measured by the occurrence of doubles was in many cases about proportionate, little evidence that mesothorium was the only thorium family parent picked up being available. To study the contribution of polonium from natural fallout, dried commercial tobacco leaves were examined with phosphors. In general the lower side appeared to show a slightly higher proportion of thorium, but numbers were too small for statistical significance. It is concluded that in spite of possible effect of surface waxes and small estimated amounts of soil dust on the surfaces of the leaf, there is probably some small effect of polonium fallout; but in the case of higher activity tobaccos it is only a minor factor compared with activity derived from soil through the roots. A test was made of lead from tetraethyl lead solution as used commercially, and there was considerably α activity when the material was treated with fuming nitric acid before precipitation to remove organic components. Scrapings from a lead exhaust pipe from an engine used for testing leaded fuels contained considerable radioactivity. Other experiments failed to prove any relation between radioactivity of tetraethyl lead and antiknock properties. The possibility of cancer induction by polonium from such sources is discussed, and the contribution of diet to polonium body burdens is reviewed. (H.M.G.)

35784 RADIOLOGICAL HEALTH DATA [MONTHLY REPORT], VOLUME V, NUMBER 6. (Public Health Service, Washington, D. C.). June 1964. 54p. $0.50(GPO).

Data are presented on the radioactivity due to fallout fission products in samples of air, milk, food, and surface waters collected at various locations throughout North America during 1963 and 1964, with emphasis on samples collided in February 1964. Data are included from environmental surveys at the Knolls Atomic Power Lab., Schenectady, N. Y., and Combustion Engineering Inc., Windsor, Conn., from July 1962 through December 1963. Two low-yield underground nuclear tests conducted during May 1964 were announced by the Atomic Energy Commission. Separate abstracts were prepared for six sections of this report. (C.H.)

For abstracts of individial sections see: 35785, 35786, 35787, 35788, 35789, and 35790.

35785 FISSION PRODUCT GAMMA ACTIVITY IN AIR—80TH MERIDIAN NETWORK, DECEMBER 1963. W. R. Collins, Jr. (Health and Safety Lab., AEC). Radiol. Health Data, 5: No. 6, 252-5(June 1964).

Results are reported for total γ activity measurements of air samples collected at 80th meridian (west) stations during December 1963. Data are included on average monthly activities for each site and the ratios of photons with energies in excess of 1 Mev to total photon activity. (C.H.)

35786 SUMMARY REPORT ON AIRBORNE FISSION PRODUCTS ALONG THE 80TH MERIDIAN (WEST), 1957–1962. L. B. Lockhart, Jr. (Naval Research Lab., Washington, D. C.), R. L. Patterson, Jr., A. W. Saunders, Jr., and R. W. Black. Radiol. Health Data, 5: No. 6, 255-65(June 1964).

Data are summarized from measurements of both gross β activity and ^{90}Sr activity in the air at ground level at sampling stations along the 80th meridian (west) from 1957 through 1960. The data are discussed in terms of the retention and transport of radioactivity within the atmosphere, the effective barrier to mixing across the Equator, and seasonal cycles in the appearance of stratospherically stored debris at ground level. (C.H.)

35787 STRONTIUM-90 IN 1963 UNITED STATES WHEAT. V. F. Pfeifer and A. J. Peplinski (Dept. of Agriculture, Peoria, Ill.). Radiol. Health Data, 5: No. 6, 282 (June 1964).

Wheat samples from the 1963 crop from major U. S. wheat-producing areas were analyzed for ^{90}Sr content. Results showed that ^{90}Sr content of 1963 wheat averaged 200 to 300 pC/kg. This is about three times that of the 1962 crop. (C.H.)

35788 STRONTIUM-90 IN PLANT PARTS AND MILLING FRACTIONS FROM A 1963 ILLINOIS WHEAT. V. F. Pfeifer, A. J. Peplinski, and J. E. Hubbard (Dept. of Agriculture, Peoria, Ill.). Radiol. Health Data, 5: No. 6, 283-4(June 1964).

Plant parts and milling fractions of wheat from the U. S. 1963 crop were analyzed for ^{90}Sr content. Results showed that in the milling fractions from hand-picked wheat, ^{90}Sr/Ca ratios varied from 94 pC ^{90}Sr/g Ca in the patent flour to 247 in the bran, with 212 in the wheat. The ^{90}Sr content in ash varied from 2.1 pC/g in the patent flour to 4.2 in the bran, with 3.8 in the wheat. In the milling fractions from field-combined wheat, ^{90}Sr/Ca ratios varied from 131 pC ^{90}Sr/g Ca in the patent flour to 313 in the bran, with 223 in the wheat. Strontium-90 in the ash varied from 4.0 pC/gram in the patent flour to 6.6 in the shorts, with 4.4 in the wheat. The flour milled from wheat contains about 1% of the total ^{90}Sr present in the aboveground wheat parts. Each one-pound loaf of white bread contains nearly 0.66% of white flour. The importance of effective milling for reducing the ^{90}Sr content in flour is stressed. (C.H.)

35789 CESIUM-137 IN TRI-CITY DIETS, AUGUST–OCTOBER 1963. J. Rivera and J. J. Kelly (Health and Safety Lab., AEC). Radiol. Health Data, 5: No. 6, 288-90 (June 1964).

Data are presented on the ^{137}Cs content in average diets of persons residing in New York City, San Francisco, and Chicago from August through December 1963. The average per person dietary consumption and ^{137}Cs intake was calculated. On the basis of ^{137}Cs levels of about 200 pC/day in the diet, it was estimated that the body burden would be 20 nC, or about $1/10$ that due to natural K in the body. (C.H.)

35790 STRONTIUM-90 AND CALCIUM IN TRI-CITY DIETS, AUGUST–OCTOBER 1963. J. Rivera (Health and Safety Lab., AEC). Radiol. Health Data, 5: No. 6, 285-8 (June 1964).

Estimates were made of the ^{90}Sr content of the average diet of individuals living in New York City, San Francisco, and Chicago from August to October 1963. Results are compared with similar data compiled since 1960. (C.H.)

35791 RADIOLOGICAL HEALTH DATA [MONTHLY REPORT], VOLUME V, NUMBER 7. (Public Health Service, Washington, D. C.). July 1964. 50p. $0.50(GPO).

Data are presented on the radioactivity due to fallout fission products in samples of air, rain water, milk, foods, representative diets, and surface water collected throughout North America during 1963 and 1964. Emphasis is placed on data collected during March 1964. Data are included on the radioactivity in air samples collected along the 80th meridian during January and February 1964 and measurements of environmental radioactivity during 1963 at the Union Carbide Nuclear Company plants at Oak Ridge, Tenn., and Paducah, Ky., and the Goodyear Atomic Corporation plant at Portsmouth, Ohio. Three low-yield underground tests at the Nevada Test Site during June 1964 were announced by the Atomic Energy Commission. Separate

abstracts were prepared for two sections of this report. (C.H.)

For abstracts of individual sections see: 35792 and 35793.

35792 STRONTIUM-90 AND CALCIUM IN INFANT DIETS, 1963. Joseph Rivera (Health and Safety Lab., AEC). Radiol. Health Data, 5: No. 7, 335-6(July 1964).

Data on the ^{90}Sr and Ca in infant diets during their first year of life were calculated from data on milk and food sampled in New York City and Chicago from October through through December 1963. Results are compared with data on the ^{90}Sr concentrations and intake of infants of New York City, Chicago, and San Francisco during 1963. These estimates are 19, 20, and 10 pC/g Ca, respectively. The expected ^{90}Sr/Ca ratio of bones of one-year-old children in 1963 was calculated to be between 6 and 7 pC/g Ca in New York and Chicago and 3 pC/g Ca in San Francisco. (C.H.)

35793 MEDICAL X-RAY UNITS IN THE CITY OF BALTIMORE: FINDINGS OF THE 1963 PILOT SURVEY. Perry F. Prather, Robert E. Farber, and Howard E. Chaney. Radiol. Health Data, 5: No. 7, 341-4(July 1964).

A survey was made of x-ray units and installations in the offices of a selected group of physicians in Baltimore, Md., during 1963. It was found that in 58.3% of the machines the primary x-ray beam exceeded the area of clinical interest and extended beyond the film, resulting in unnecessary exposure of the patient. Insufficient filtration was found in 51.8% of the units checked and this also resulted in exposure of the patient. In approximately 20% of the installations surveyed there was insufficient shielding to protect persons outside the x-ray room from the primary x-ray beam. Deficiencies were also found in 91.9% of the fluoroscopic units surveyed. More than 75% of the 202 x ray units surveyed were deficient in one or more of the items considered necessary to meet minimum standards. (C.H.)

35794 THE DANGER OF IONIZING RADIATION. J. Vassaux. Rev. Protect., No. 50, 66-70(Oct. 1962); No. 51, 55-60(Nov. 1962); No. 52, 61-8(Dec. 1962); No. 53, 47-51(Jan. 1963); No. 54, 43-50(Feb. 1963); No. 55, 58-64(Mar. 1963); No. 56, 45-51(Apr. 1963). (In French)

The dangers of ionizing radiation, originating from peaceful uses of nuclear energy, are reviewed for the layman. The terms used in a discussion of ionizing radiation, atomic structure and characteristics, and units of measurement are defined in the introduction. The origin and nature of ionizing radiations are discussed, and the effects of radiation on the human organism are considered. The principal applications of these radiations are in scientific research, medicine, agriculture, propulsion, industry, and monitoring devices, and each of these is described. The methods used for protection against radiation are considered. (J.S.R.)

35795 BIOLOGICAL SEQUELAE OF RADIOACTIVE SUBSTANCES IN FOOD. J. Spaander (Rijksuniversiteit, Utrecht). Tijdschr. Sociale Geneesk, 41: 787-98(1963).

For effective control of the biological sequelae of radioactive substances in food, as a result of the discharge and spread in the atmosphere of these substances associated with the peaceful application of nuclear energy in general, and particularly as a result of radioactive fallout following nuclear explosions, it is necessary to regard this public health chapter as a whole. This overall aspect is closely correlated with the way in which the biological sequelae of ionizing radiation must be interpreted as risk of future damage according to knowledge and data now available. As a direct consequence of this conception, the Ministry of Social Affairs and Public Health, which in this respect is responsible for the protection of the population's health, should on the one hand possess the apparatus for laboratory research into radioactive contamination of the human biotope in the widest sense and for summarizing the findings in a meaningful review, while on the other hand it should maintain an organization which unites both the scientists and the authorities, enabling both to make broad decisions rapidly and effectively on the basis of current observations and, if necessary, to advise as to measures to be taken. If anywhere, Pasteur's assertion that there is only applied science holds true for the field of radiation hygiene, in which field hardly acquired biological knowledge must be applied in practice under unusually complicated conditions. (Excerpta Med., Sect. 23, 1: No. 7, 1964)

35796 SCHUTZ VOR MASSENVERNICHTUNGSMITTELN. SCHUTZ VOR KERNWAFFEN, CHEMISCHEN KAMPFSTOFFEN UND BIOLOGISCHEN KAMPFMITTELN. (Protection Against Mass Destruction Devices. Protection Against Nuclear Weapons, Chemical Warfare Agents, and Biological Warfare Agents). A. Langhans, E. Haase, and R. Geipel. Berlin, Deutscher Militarverlag, 1963. 114p.

A handbook for the layman outlines precautions to be taken against nuclear weapons, chemical warfare agents, and biological warfare agents. Decontamination measures to be followed in case of contamination or contact with these agents are included. (J.S.R.)

35797 SHIPPING OF RADIOACTIVE MATERIALS. Juergen Nesselmann (Kernreaktor Bau- und Betriebs-GmbH, Karlsruhe, Ger.). p.372-5 of "Atomstrahlung in Medizin und Technik." Munich, Verlag Karl Thiemig KG, 1964. (In German)

The legal specifications for the shipping of radioactive materials in Germany are briefly indicated. The practical consequences that arise from conformity to these regulations are reported. The transportation costs for radioactive materials are compared with such costs for non-radioactive materials. (J.S.R.)

35798 SAFETY PLANNING AND RADIATION LIABILITY INSURANCE IN MEDICINE AND INDUSTRY. W. Mueller (Allianz Versicherungs-AG, Munich). p.376-80 of "Atomstrahlung in Medizin und Technik." Munich, Verlag Karl Thiemig KG, 1964. (In German)

The problems created for insurance companies in defining radiation liability in medicine and industry are reviewed. The formulation of the relation between premiums and radiation damage is indicated. (J.S.R.)

35799 TECHNIQUES AND RESULTS OF PERSONAL DOSE MEASUREMENT USING FILM. F. Wachsmann (Universität, Erlangen, Ger.). p.381-9 of "Atomstrahlung in Medizin und Technik." Munich, Verlag Karl Thiemig KG, 1964. (In German)

The techniques used to make film dosimeters energy-independent are indicated, and the characteristics of the film dosimeters are discussed. Other devices used for personnel monitoring are briefly summarized. The utilization of film badges in Germany and the results obtained on the radiation burden received by personnel are reported. (J.S.R.)

35800 EXPERIENCE IN THE MEASUREMENT OF RADIOACTIVE GAS AND DUST IN THE URANIUM MINES IN JAPAN. N. Fusamura (Waseda Univ., Tokyo), R. Kurosawa, and H. Misawa. 20p. (CONF-561-3)

From Symposium on Inhaled Radioactive Particles and Gases, Richland, Wash., May 1964.

Experiences in the measurements and the evaluations

of radon, radon daughter products, and radioactive dust in Japanese uranium mines are described. The measurement of RaA free ion in mine air and the conception on the age of radon emanated from the ore bodies or mine water are also presented. (auth)

35801 NUCLEAR MATERIALS MANAGEMENT PRINCIPLES USED BY ATOMIC ENERGY OF CANADA LTD. W. G. Jenkinson. 13p. (CONF-620-1)

From Institute of Nuclear Materials Management 5th Annual Meeting, Pittsburgh, May 1964.

The nuclear materials management program at AECL is described and outlined. It was found that by combining the administration of all aspects of nuclear materials management in one branch a close relationship was obtained between the various areas. This has resulted in an efficient and effective system of control. (P.C.H.)

INSTRUMENTATION

General

Refer also to abstracts 35953 and 36054.

35802 (AD-434235) RESEARCH AND INVESTIGATION ON RADIATION RESISTANT, HIGH TEMPERATURE THERMIONIC CIRCUITRY. FEASIBILITY STUDY OF POWER TRIODE. Interim Engineering Report, September 1, 1963–January 31, 1964. (General Electric Co. Receiving Tube Dept., Owensboro, Ky.). Contract AF33(657)-12329. 39p.

The relative merits of planar and cyclindrical triode geometries are discussed, together with the heat dissipation problem and required cathode area. The salient features of both a planar and a cylindrical electrode tube design are presented. The functional purpose is stated for various parts and assemblies. Data relating tube temperature dependence upon plate power input and saturated plate current dependence upon temperature were obtained from a prototype triode with basket-type wire mesh grid. The basket grid proved undesirable because of grid deformation tendencies. Planar power triodes with parallel wire grids were constructed which had plate family characteristics very near the objective. (auth)

35803 (AD-439240) ELECTRON TUBES RADIATION RESISTANT. PILOT LINE PRODUCTION. Second Quarterly Progress Report, September 1, 1963–November 30, 1963. F. B. Parks and John F. Grimm (Chatham Electronics. Div. of Tung-Sol Electric Co., Livingston, N. J.). Dec. 31, 1963. Contract DA-36-039-AMC-01476(E). 60p.

Efforts were expended on a pilot line production capability for producing nuclear-radiation-resistant electron tube types 6080WB, 6360, 5886 and 6205. Improvements were made to the stem-making and glass-sealing equipment, as well as to the stem-forming molds. The techniques and processes pertaining to both these operations were modified in line with the indicated direction of higher yield and lower shrinkage. Work has proceeded with the design and construction of equipment, such as: high-temperature, dual-vacuum exhaust station; a 500°C life test kit; power preheaters, static characteristics sets, aging racks, and a voltage gain test set; and modification to the pinch press type sealing machine for the 5886 tube. (auth)

35804 (BNL-7219) INEXPENSIVE TEMPERATURE CONTROL PROVIDES .01 DEGREE STABILITY. E. J. Rogers (Brookhaven National Lab., Upton, N. Y.). [nd]. Contract [AT(30-2)-Gen-16]. 4p.

A circuit is described that provides true proportional control with its attendant advantages but is extremely simple and requires only a 6.3 v a-c power source. The circuit was used in conjunction with an oven to control the temperature of a Zener diode used as a precise voltage reference. Over a period of one week, the temperature did not drift more than 0.01°C from the preset value of approximately 50°C. The room temperature varied over a range of 5°F during the same period. (P.C.H.)

35805 (BSR-847) RADIATION EFFECTS PARAMETERS IN NAP APPLICATIONS. Fifth Monthly Progress Letter, December 1963. (Bendix Corp. Bendix Systems Div., Ann Arbor, Mich.). Jan. 16, 1964. Contract AF29 (601)-5911. 18p. (AD-437878)

The relative neutron-to-gamma ray comparison will be made by comparing gamma and reactor tests. That is, the results will give direct comparison between cobalt-60 gamma effects and "soft" neutron spectra and also cobalt-60 effects and "hard" neutron spectra. Some of the tests will give information about radiation damage as a function of measuring conditions for a few device types. If the results of the comparisons show that the relative damage effects are fairly independent of device type and operating conditions, then it may be possible to generalize these results for large classes of semiconductor components. On the other hand, if the results of the comparisons exhibit considerable variation, then it will be necessary to limit their use in terms of classes of devices and operating conditions. (auth)

35806 (DP-869) DESIGN OF CONDUCTIVITY CELLS FOR STRONG ELECTROLYTES. Robert C. Propst (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). June 1964. Contract AT(07-2)-1. 25p.

Design and operating characteristics of conductivity cells were examined to improve the accuracy and precision of conductance data from highly conductive process solutions. The characteristics investigated included cell dimensions, size and nature of electrodes, and frequency and voltage ranges. Cell designs that confined the solution in a long column (where length $\gg$ diameter) minimized the importance of constant electrode area and virtually eliminated the effect of fouling of electrode surfaces by entrained organic solvents. Satisfactory operation with simulated dissolver solution from the Purex process was demonstrated with several cells constructed from new design criteria. (auth)

35807 (GEMP-83) REACTOR INSTRUMENTATION AND CONTROL PROGRESS REPORT NO. 83. (General Electric Co. Advanced Technology Services, Cincinnati). July 31, 1964. Contract AT(40-1)-2847. 25p.

The development and testing of high-temperature capacitance thermometers using Al_2O_3 or BeO sensing elements are described. The development of components for a high-temperature a-c ionization chamber is reviewed. The characteristics of a charged-fragment neutron detector are summarized. (T.F.H.)

35808 (HW-82009) NEUTRON SOIL MOISTURE MONITOR. E. M. Sheen, W. L. Bunch, and M. R. Wood (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). May 1964. Contract AT(45-1)-1350. 22p.

The neutron soil moisture monitor was developed as a geophysical well-logging tool to measure directly the moisture content of the sediments adjacent to test wells. The instrumentation system includes: a probe which contains a fast neutron source, slow neutron detectors, and necessary solid state circuitry; a supporting and signal transfer cable; a cable drum and winch; a count rate meter; and a recorder. The probe contains five BF_3 proportional counter tubes, an amplifier, a high voltage supply, and a 1 curie Pu–Be neutron source. A single coaxial cable supports the probe, returns signal information to ground-level instrumentation, and conveys low voltage power to the probe. A pulse height discriminator and a power supply are located at ground level. The probe signal pulses are decoupled from the low voltage power bus. integrally discriminated, and used to drive

a conventional count rate meter and strip chart recorder combination. (auth)

35809 (NYO-10559) APPLICATIONS OF ULTRASONIC ENERGY: ULTRASONIC INSTRUMENTATION FOR NUCLEAR APPLICATIONS. Bimonthly Progress Report No. 9, February 1–March 31, 1963. (Aeroprojects, Inc., West Chester, Penna.). Apr. 1963. Contract AT(30-1)-2910. 16p.

The principle of void fraction measurement employed in the construction of a primary standard of measurement has been tested, and experimental data appear to agree with values predicted from theory. An experimental apparatus is being constructed. An acoustic thermometer, based on the principle of phase difference in acoustic traveling waves, is being constructed. (auth)

35810 (NYO-10610) APPLICATIONS OF ULTRASONIC ENERGY: ULTRASONIC INSTRUMENTATION FOR NUCLEAR APPLICATIONS. Bimonthly Progress Report No. 11, June 1–July 31, 1963. (Aeroprojects, Inc., West Chester, Penna.). Aug. 1963. Contract AT(30-1)-2910. 10p.

Apparatus for the steady state generation of known quantities of void fractions in water covering a range up to around 40 percent is being completed and tested. This will be used for test and demonstration of an acoustic void fraction meter, the principles of which will be applicable to other more inaccessible liquid-vapor systems such as those occurring in molten-metal reactors. Development of the acoustic phase shift thermometer is continuing. Unexpected difficulties developed during the tests of the molybdenum sensing elements, in that poor bonding between the molybdenum and other metals, particularly the lead in the absorber, resulted in lack of reproducibility in the data. The problem has been isolated, and other procedures for wetting and joining molybdenum are being investigated along with the possible use of other refractory metals. An acoustic, continuous, liquid-level gage operating at a nominal frequency of 50 kc has been completed. The design of this unit is based on the principle of the curved-horn probe, but use of a high frequency permits a compact design. Preliminary tests with the new unit show a continuously changing response with depth of immersion. (auth)

35811 (RISO-80) TWO ELECTRONIC ANALOG-TO-DIGITAL CONVERTERS. L. P. Goodstein (Denmark. Atomenergikommissionen. Forsøgsinstitut, Risø). Feb. 1964. 77p.

A brief introduction to the subject of electronic analog-to-digital converters, and a description of the activities carried on at Risö in this field are presented. This work included the development of a precision reference switch, a comparator, and a complete eight-bit comparison-feedback encoder. In addition, another type of converter employing a cascade of bi-stable elements was designed, built, and evaluated. (auth)

35812 (UCLA-12-529(p.63-7)) BIOPHYSICS. (California. Univ., Los Angeles. School of Medicine. Lab. of Nuclear Medicine and Radiation Biology).

The performance of a high-quantum-utilization scanner for the localization of brain tumors is discussed. The use of a multichannel cell-size spectrum analyzer in lymphocyte studies is described. (C.H.)

35813 (USNRDL-TR-763) GAMMA AND X-RAY EFFECTS IN MULTIPLIER PHOTOTUBES. H. A. Zagorites and D. Y. Lee (Naval Radiological Defense Lab., San Francisco). July 7, 1964. 33p.

The effects of gamma and x-radiation exposure rate have been determined in 4 common multiplier phototube types over an intensity range of about 1 to 10^{10} r/hr. Radiation-induced anode current was essentially a linear function of exposure rate up to about 10^4 r/hr and reached values of 10^{-4} to 10^{-3} amperes at 10^5 r/hr steady-state. Above 10^5 r/hr, peak values of anode current as high as 50 ma were observed with pulsed x rays of 0.2 μsec duration. The output of all tubes was essentially space-charge-limited at peak exposure rates greater than 10^7 to 10^8 r/hr; however, anode current recovery time to the pre-irradiation levels in three tube types increased with exposure rate, and recovery times of 6 to 30 μsec were observed at 10^{10} r/hr. This delay could not be explained clearly from the results but may be related to tube insulator spacer charging due to large rapid increases of anode current. The principal radiation sensitivity of all tubes was due to radiation-induced luminescence of the face plates and glass envelopes, and tube response increased with anode luminous sensitivity. The dynode structure and its configuration did not contribute significantly to the radiation-induced response. Radiation sensitivity can be reduced significantly through the use of non-luminescent materials in tube construction. (auth)

35814 (AEC-tr-6453) HIGH-TEMPERATURE CALORIMETRY. Michele Dupre, Jean Elston, and Louis Sicard. Translated from Compt. Rend., 256: 90-2(1963). 7p. (Includes original, 3p.).

A calorimeter utilizing the heat conduction of a solid is proposed. The heat is transferred between the wall of measurement and the sample by radiation. As a result the sample must occupy a well-defined geometrical position. The use of high temperatures improves the performance of the apparatus. It permits the determination of the energy stored in spherical samples of irradiated BeO. (P.C.H.)

35815 MASS DISCRIMINATION IN A 180° MASS SPECTROMETER. APPLICATION TO EVALUATION OF INITIAL KINETIC ENERGY OF IONS. J. Collin, J. Delwiche, and L. D'or (Université, Liège). Bull. Classe Sci., Acad. Roy. Belg. (5), 49: 1244-63(1963). (In French)

An experimental study is made of the mass discrimination that occurs in a 180° mass spectrometer. For ions having only thermal initial kinetic energy (Ne^+, Kr^+, Xe^+, CH_4^+, $C_3H_8^+$, iso-$C_4H_8^+$, SO_2^+, $C_6H_6^+$, and C_6H_5-CH_3^+), the experimental results indicate a rather large effect. Up to now, no satisfactory theoretical approach for the mass discrimination effect can be undertaken. Fragment ions having kinetic energy were also studied (ions from CO, C_3H_8). Mass discrimination effects allow a rough estimation of initial kinetic energy of such ions; original results are given for ions yielded by the fragmentation of CO_2. (auth)

35816 A 100 Mc/s GROUNDED GRID OSCILLATOR FOR USE WITH AN RF ION SOURCE. J. Ashbridge (United Kingdom Atomic Energy Authority, Sellafield, Cumb, Eng.). Nucl. Instr. Methods, 29: 40-2(Sept. 1964).

A grounded grid oscillator operating at a frequency of 100 Mcps and its use for driving the r-f ion source of an accelerator are described. The oscillator uses a single triode valve type TY2-125 and has an r-f output power in excess of 300 w with a total power input of only 500 w. The mechanical design is simplified by the use of a coaxial bifilar feedback coil to carry the heating current to the valve filament. Provision is made for pulsing the output of the oscillator for pulsed beam accelerator experiments. The performance characteristics of the oscillator and necessary modifications to the ion source for increased r-f

power input are discussed. The maximum deuteron beam current of the accelerator was increased from 0.7 to 1.6 mamp by increasing the r-f power from 75 to 300 w. (auth)

35817 BEHAVIOR OF COAXIAL CABLE CONNECTORS FOR PULSES WITH NANOSECOND RISETIMES. R. B. Schwartz and A. C. B. Richardson (National Bureau of Standards, Washington, D. C.). Nucl. Instr. Methods, 29: 83-8(Sept. 1964).

Reflections and risetime distortion caused by connector mismatches were measured for several common cable-connector combinations, using a fast pulser and sampling oscilloscope (system risetime = 0.4 nsec). It was found that excellent connectors are available for a 125Ω (RG 63/U) cable, as well as for 50Ω cables. In addition, details are given for the construction of a connector which may be used with a 185Ω (RG 114/U) cable. Measurements are also reported for 125Ω attenuators and a 125Ω pulse inverting transformer. (auth)

35818 ON A TUNNEL DIODE FAST DISCRIMINATOR. B. Righini (Università, Bologna). Nucl. Instr. Methods, 29: 89-92(Sept. 1964).

A fast voltage amplitude discriminator based on a tunnel diode is described. The circuit can analyze pulses the amplitudes of which range between 0.4 and about 6.5 v and gives a fast standard output pulse 9.5 v high and 28 ns wide, with a rise time <2 ns. The circuit is stable for input pulse frequencies between 10 c/s and 10 Mc/s and for room temperature variations between 0 and 45°C. (auth)

35819 MONOSTABLE SYSTEMS TRIGGERED AT RANDOM. B. Souček (Institute "Ruder Boskovic," Zagreb). Nucl. Instr. Methods, 29: 109-14(Sept. 1964).

Random triggering of monostable systems is analyzed. It is shown that the duration of the quasistable period is not constant, but becomes a stochastical variable, the statistical distribution of which depends on the triggering event rate and on the recovery time constant of a system. The distributions are calculated and plotted in normalized form and are verified by experimental results. Identical distributions for all considered monostable systems are obtained. (auth)

35820 A NEW INSTRUMENT FOR DC VOLTAGE STABILITY MEASUREMENT AND CONTROL. W. K. Brookshier and R. N. Lewis (Argonne National Lab., Ill.). Nucl. Instr. Methods, 29: 141-8(Sept. 1964).

An operational invertor for monitoring the stability of d-c voltage sources is described, which uses a vibrating reed electrometer and capacitors as input and feedback elements. The output voltage signal is an amplified version of the input voltage change with the d-c level removed. The system was tested in the voltage range to 1 kv. Changes in the voltage source as small as one part in 10^7 can be displayed. (D.C.W.)

35821 SINGLE CHANNEL SELECTOR FOR TUNNEL DIODES. Ch. Mantakas (Centre Nucleaire "Dimocritos," Athens). Nucl. Instr. Methods, 29: 177-9(Sept. 1964).

A gating circuit is described. The rise time is >30 nsec, and input pulses and the channel width range from 0.5 to 10 v and 70 to 200 mv, respectively. (D.C.W.)

35822 A FILTER FOR OPTICAL PUMPING IN CESIUM. M. P. Chaika and N. N. Yakobson. Opt. Spectr. (USSR) (English Transl.), 16: 487-8(May 1964). Translated from Opt. i Spektroskopiya, 16: 899-901(May 1964).

An arrangement is proposed that allows the intensity ratio of the hyperfine components in an irradiating light to be changed by a factor of several times unity; the filter is based on the principle of the Fabry-Perot interferometer. The filter parameters were calculated for optical pumping of one of the hyperfine levels of the ground state of Cs. Operating conditions and performance of the filters are discussed. The interference filter has great advantages since the intensity difference is established outside the volume occupied by the vapor and in the pumping process the fluorescence yield is reduced. (P.C.H.)

35823 IMPROVEMENTS IN OR RELATING TO MASS SPECTROMETERS. Norman Richard Daly (to United Kingdom Atomic Energy Authority). British Patent 965,020. July 29, 1964. Filed May 29, 1962.

An ion beam intensity measurement device is designed for measuring simultaneously two ion beams in a mass spectrometer. The device comprises two chambers separated by an electrostatic boundary and each having an inlet for a separate ion beam, an electrode in each chamber for deflecting the ion beam away from the boundary, a target in each chamber for producing secondary electrons from the ion beam, a magnetic field for deflecting the secondary electrons away from the boundary, and scintillation detector means for measuring the secondary electrons. (D.L.C.)

35824 MEANS FOR REDUCING THE MEMORY EFFECT IN A MASS SPECTROMETER ION SOURCE. Allan N. Hamer and Colin C. McCormick (to United Kingdom Atomic Energy Authority). U. S. Patent 3,142,752. July 28, 1964. Priority date Aug. 17, 1959, Great Britain.

A mass spectrometer ion source assembly is designed to minimize the memory effect in the isotopic analysis of UF_6 samples. The pipe for introducing the samples into the ion source is designed to minimize the adsorption of UF_6 on the wall of the pipe. (D.L.C.)

35825 PHOTOMULTIPLIER TUBE WITH TUBULAR CATHODE BONDED TO THE INTERIOR SURFACE THEREOF. Clark Goodman and Jean-Pierre Causse (to Schlumberger Well Surveying Corp.). U. S. Patent 3,142,756. July 28, 1964. Filed Nov. 23, 1959.

An instrument is designed for simultaneous neutron-neutron and neutron-gamma well logging. The instrument uses only one photomultiplier tube and one electrical channel; a neutron-sensitive layer is provided in the photomultiplier envelope, and the pulses due to gammas and neutrons are separated by means of a pulse height discriminator. (D.L.C.)

35826 COINCIDENT PULSE SUPPRESSION SYSTEM FOR SIMULTANEOUS RADIOACTIVITY WELL LOGGING. Raymond B. Basham (to The Western Co.). U. S. Patent 3,142,757. July 28, 1964. Filed Apr. 8, 1960.

An instrument is designed for preventing the time-coincidence of two pulses of opposite kind in simultaneous neutron and gamma logging. The instrument is provided with a device for giving priority to the pulses of one kind in the event of coincidence. Thus, the loss of both pulses is avoided. (D.L.C.)

35827 APPARATUSES FOR MEASURING THE COEFFICIENT OF THERMAL CONDUCTIVITY OF SOLID MATERIALS. Paul Cogez, Jacques Humbert, and Claude Gewiss (to Commissariat à l'Énergie Atomique). U. S. Patent 3,142,979. Aug. 4, 1964. Priority date Apr. 15, 1959, France.

An improved apparatus is designed for measuring the thermal conductivity of solids by the steady heat flow method. Provision is made for taking up expansions and length differences between samples. Two embodiments of the apparatus are described. (D.L.C.)

35828 APPARATUS FOR MEASURING MAGNETIC FIELDS. Georges Bonnet and Antoine Salvi (to Commissariat à l'Énergie Atomique). U. S. Patent 3,145,336. Aug. 18, 1964. Priority date Dec. 16, 1958, France.

A magnetometer for measuring very weak magnetic fields is designed which uses the spontaneous emission of energy at a frequency proportional to the magnetic field. The magnetometer comprises a solution of a solvent having an angular momentum and a magnetic moment and a paramagnetic substance which emits energy when one of the electronic resonance lines is saturated, a high-frequency coil for creating a polarizing field in the solution, and a low-frequency coil for collecting the emitted energy. An electronic network with a negligible input susceptance is also provided for the automatic adjustment of the self-oscillation conditions of the low-frequency circuit. (D.L.C.)

Radiation Detection

Refer also to abstract 36217.

35829 (AERE-M-1210) THE USE OF AN ADIABATIC CALORIMETER FOR THE MEASUREMENT OF THE DISINTEGRATION RATIO OF COBALT-60. A Preliminary Report. R. L. Otlet and D. R. Lewis (United Kingdom Atomic Energy Authority. Research Group. Isotope Research Div., Wantage, Berks, England). Apr. 1963. 16p.

An adiabatic lead calorimeter was constructed for the measurement of the disintegration rate of γ emitters. In a preliminary experiment, a 1 C ^{60}Co source was calibrated; the value obtained, (1.280 ± 2%) C, is in good agreement with the figure obtained previously by ionization chamber measurements and absolute counting, (1.261 ± 3%) C. (auth)

35830 (AFCRL-64-166) IMPROVEMENT OF PHOTOMULTIPLIER RESPONSE AND DEVELOPMENT OF A DEVICE FOR MEASUREMENT OF kev AURORAL ELECTRONS. Final Report. Richard C. McCall and Alfred C. Jasins (Controls for Radiation, Inc., Cambridge, Mass.). Apr. 27, 1964. Contract AF19(628)-2910. 27p. (AD-438427)

The limitations and capabilities of various detectors, especially photomultipliers, are reviewed. Two methods, use of constant response fluors and use of choppers, are suggested for improvement of photomultiplier responses. A new type of detector is discussed and suggested for further development. The use of a LiF thermoluminescent dosimeter for detection of electrons is described. Experimental work leading to the present functioning system is presented. The response of this system to ^{60}Co gamma rays, uranium beta rays, and to 7-kev electrons is given. (auth)

35831 (AFSWC-TDR-62-107) PASSIVE DOSIMETRY ANALYSIS TECHNIQUES. Richard Griffith, Harry Murphy, and Donald Wood (Air Force Special Weapons Center, Kirtland AFB, N. Mex.). Jan. 1964. 35p. (AD-432686)

Techniques required to analyze standard neutron foil and gamma dosimetry are summarized. Levels of accuracy and the conditions under which they can be obtained are discussed. Techniques involve total gamma dose measurement, total neutron flux measurement, and determination of a six-group neutron-energy spectrum. (auth)

35832 (ANL-6881) AN INTRODUCTION TO MULTICHANNEL ANALYZERS. George S. Stanford (Argonne National Lab., Ill.). Apr. 1964. Contract W-31-109-eng-38. 21p.

A survey of the state-of-the-art of multichannel pulse analysis is presented. There is no attempt to treat any topic in depth. The general principles of analysis of pulse height and time-of-flight are outlined, with consideration given both to single-parameter and multiparameter instruments. Memory systems, analog-to-digital conversion, and readout devices are discussed. Some of the features and limitations of modern analyzers are noted, and typical performance specifications are given. Although the main emphasis is on instrumentation, mention is made of some of the applications of single- and multiparameter analysis. (auth)

35833 (BNL-852) A HIGH CAPACITY DIGITAL DATA HANDLING SYSTEM FOR USE WITH COUNTER HODOSCOPES AND DIGITIZED SPARK CHAMBERS IN ON-LINE COMPUTER AGS EXPERIMENTS. K. J. Foley, W. Higinbotham, S. J. Lindenbaum, W. A. Love, S. Ozaki, D. Potter, and L. C. L. Yuan (Brookhaven National Lab., Upton, N. Y.) Mar. 1, 1964. Contract AT-30-2-GEN-16. 9p.

The digital data handling system for the Brookhaven AGS is described. The system consists of 200 fast gates, two 48 × 4096-bit memory units, magnetic tape transports, and a direct data link to the Merlin computer. (auth)

35834 (BNL-7282) THE PHOTOGRAMMETRY OF THE TRACKS OF ELEMENTARY PARTICLES IN BUBBLE CHAMBERS. John F. Garfield (Brookhaven National Lab., Upton, N. Y.). Aug. 15, 1963. Contract [AT(30-2)-Gen-16]. 26p.

Photographic techniques used for mapping elementary particle interactions are reviewed. Emulsion stacks, hydrogen bubble chambers, and spark chambers are discussed; data acquisition and reduction are considered. (R.E.U.)

35835 (BNL-7283) METHOD FOR COMPARING SMALL AC VOLTAGES IN THE PRESENCE OF LARGE DC COMPONENTS. E. J. Rogers (Brookhaven National Lab., Upton, N. Y.). [nd]. Contract [AT(30-2)-Gen-16]. 7p.

A feedback technique was developed to equalize the d-c levels of two signal sources so that a-c signal components, which are much smaller than the d-c levels, can be compared accurately without introducing a low-frequency cutoff and consequent rate-dependency into the system. A digital integrator in the feedback loop provides a highly stable long-term "memory" so that the correct level will be maintained during intervals when the signals are "frozen" at some arbitrary point. The technique was developed for the flying spot digitizer constructed at Brookhaven for bubble chamber picture reading, but may be used in any application where the d-c level of at least one of the compared signals may be varied by a d-c controlling voltage. (auth)

35836 (CRC-1101) MEASUREMENT OF FISSION NEUTRON FLUXES AND SPECTRA WITH THRESHOLD DETECTORS. J. C. Roy, R. W. Durham, A. G. Fowler, and J. J. Hawton (Atomic Energy of Canada Ltd., Chalk River, Ont.). May 1964. 35p. (AECL-1994)

The spectral shape of the neutron flux above ~0.5 Mev in the D_2O moderated reactor NRX was investigated because of its importance in studies of radiation damage, reactor shielding, and fast fission of reactor fuel. The deviations from a pure fission flux over the energy sen-

sitive regions of several threshold reactions were measured for several irradiation positions. A hollow natural uranium rod in a beam hole was used as a fission neutron source and the reaction $^{58}Ni(n,p)$ was used to normalize each irradiation. The results for an empty lattice position were used to compute the spectrum in this position. (auth)

35837 (HW-81986) REGENERATING DETECTING TECHNIQUES FOR REACTOR NEUTRON FLUX MONITORING. W. L. Bunch (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). May 1964. Contract AT(45-1)-1350. 24p.

Regenerating detecting elements provide one method of extending the useful lifetime of reactor neutron flux monitors employing the fission reaction. A calculational technique was programmed to determine the detector initial isotopic composition to be employed in a given reactor environment. Important input parameters for the calculation include the cross sections, which are dependent on the irradiation environment, and an experimental technique was developed to determine effective cross sections in typical reactor environments for use in the computer program. The cross section notation of Westcott was used to approximate the effect of neutron spectrum. It was not possible to utilize the usual radioactive techniques for determining the neutron spectral parameters because of the incremental exposures received in the irradiation facility; therefore, the isotopic ratio technique was exploited. After determining the neutron spectral parameters in the facility, calculations were made to determine the optimum initial composition for regenerating detectors in that environment. Detectors with approximately the calculated optimum composition were irradiated and their experimental exposure dependence compared with the calculated results. It is concluded from the agreement between experiment and calculations that the technique provides regenerating detectors within the known accuracy of the cross sections. The regenerating plutonium elements used in the study exhibited a useful lifetime approximately four times that expected of a simple ^{235}U detector even though the plutonium cross sections are significantly larger. The useful lifetime of regenerating detectors employing fertile material with smaller cross sections would be correspondingly longer. Uranium regenerating elements are being employed in ionization chambers; it is assumed that regenerating elements could be employed in any system based on the detection of the fission event. (auth)

35838 (LF-14) A GAMMA-RAY DETECTOR OF VARIABLE GEOMETRY FOR WHOLE BODY COUNTING OF SMALL ANIMALS. Technical Progress Report. R. M. Goodrich, R. G. Thomas, and S. R. Wright (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.). July 1964. Contract AT(29-2)-1013. 20p.

A gamma detector for counting small animals in metabolism cages was constructed. The cage is centered between horizontal coaxial NaI crystals. By varying the distance of separation between the crystals the counting efficiency of the detector for ^{131}I can be varied from approximately 6% to 0.24%, making it possible to count a wide range of source activities. The detector is shielded by four inches of lead which allows for considerable stability in background counting rates. Various aspects of the counter performance were studied and are presented in graphical form with some discussion of the characteristics. These include determinations of efficiency as a function of crystal separation, gamma ray energy, and point versus bulk source. A short treatment of the effect of scattering is also included. (auth)

35839 (NAA-SR-9748) THE CONTINUOUS NEUTRON FLUX MONITOR PROJECT. An Interim Report. Charles R. F. Smith and Thomas H. Springer (Atomics International, Div. of North American Aviation, Inc., Canoga Park, Calif.). Aug. 1, 1964. Contract AT(11-1)-Gen-8. 73p.

A new concept for continuously monitoring neutron flux was successfully tested. A system based on this concept has several important advantages over presently used methods: it does not suffer from neutron burnup of the sensing material; it does not suffer from degeneration of electrical insulation in-core cabling; and it can be protected from loss of sensitivity resulting from in-core radiation levels. The concept consists in passing a neutron-sensitive fluid through a reactor in such a way that the concentration of neutron-formed products in the effluent stream can be used to measure neutron flux at a chosen in-core location. Three fluid systems utilizing this concept were evaluated. These were: uranium hexafluoride, which by an (n,f) reaction forms delayed neutron emitting nuclides; boron trifluoride gas, which by an (n,α) reaction produces ^{7}Li; and argon-40 gas, which by (n,γ) reaction produces radioactive ^{41}Ar. Of these three systems, the argon activation method proved to be the most practical. Its feasibility was proven by tests in the KEWB reactor where it showed linear response over a three-decade range of reactor power. There appear to be no inherent limitations in extending this range several more decades. The argon method was also successfully used in flux mapping the L-77 reactor, a 10-watt water-boiler-type research reactor. It was demonstrated that this system can be sensitive to changes in the temperature of the fluid as well as to changes in neutron flux. The development of a temperature compensated system is the basis of subsequent work on this concept. (auth)

35840 (R64SD-10) TENTATIVE PROCEDURES FOR MEASURING NEUTRON FLUX BY RADIOACTIVATION TECHNIQUES. J. B. Trice and M. S. Wechsler (General Electric Co. Missile and Space Div., Philadelphia). Feb. 1964. 33p. (AD-433154)

A general method is described for measuring reactor neutron flux energy spectral parameters by means of materials activation. Nuclear properties of the materials such as cross sections and decay schemes, counting methods, and data analyses are discussed. Particular attention is given to the use of uniform procedures for obtaining reproducible measurements. The use of resonance elements for measuring the epithermal region, and so-called threshold detectors for analysis of the higher energies are described. (auth)

35841 (TID-20422) DEVELOPMENT OF A HIGH-SPEED PHOTOMULTIPLIER. Progress Report, June 22–December 22, 1961. Charles E. F. Misso and E. J. Sternglass (Westinghouse Electric Co. Electronic Tube Div., Elmira, N. Y.). Contract AT(30-1)-2825. 18p.

The development of high-speed photomultipliers employing transmissive dynodes is reviewed. The feasibility of using metal-mesh and thin-film dynode stages is analyzed. Photomultiplier fabrication is discussed. (T.F.H.)

35842 (TID-20423) DEVELOPMENT OF A HIGH-SPEED PHOTOMULTIPLIER. Progress Report, July 2–October 2, 1962. W. W. Sapp and E. J. Sternglass (Westinghouse Electric Corp. Electronic Tube Div., Elmira, N. Y.). Contract AT(30-1)-2825. 11p.

The development of reproducible fabrication techniques for high-speed photomultipliers incorporating transmissive dynodes is discussed. Design modifications and testing equipment are described. (T.F.H.)

35843 (TID-20424) DEVELOPMENT OF A HIGH-SPEED PHOTOMULTIPLIER. Annual Report, June 22, 1961–June 22, 1962. W. W. Sapp and E. J. Sternglass (Westinghouse Electric Corp. Electronic Tube Div., Elmira, N. Y.). Contract AT(30-1)-2825. 38p.

Two prototype tubes were prepared. A complete description of these tubes is given. (auth)

35844 (TID-20425) DEVELOPMENT OF A HIGH-SPEED PHOTOMULTIPLIER. Progress Report, January 2–July 2, 1963. W. W. Sapp (Westinghouse Electric Corp. Electronic Tube Div., Elmira, N. Y.). Contract AT(30-1)-2825. 28p.

Emphasis was placed on the development of a front-end design and on a study of the pulse response characteristics of the hybrid structure. The front-end design incorporates a semi-transparent bi-alkali photocathode deposited directly on the end-window of the tube. These cathodes have exhibited sensitivites ~40 μa/lumen stability. After a detailed analysis of the WX 5009 pulse-response characteristics, modifications in the silver-magnesium mesh dynode design are proposed that should significantly improve the rise-time and total transit time in the device. Studies are carried out on the feasibility of incorporating high-gain smoke KCl dynodes in the existing structure. (auth)

35845 (TID-20895) DEVELOPMENT OF A FIVE-INCH HIGH-SPEED PHOTOMULTIPLIER. Final Technical Report, June 10, 1963–June 9, 1964. F. A. Helvy (Radio Corp. of America. Industrial Tube and Semiconductor Div., Lancaster, Penna.). Contract AT(30-1)-3190. 47p.

The RCA developmental tube type C70133 is a fourteen-stage, five-inch photomultiplier having the following characteristics: short pulse rise time; small transit time spread; uniform collection efficiency over a great fraction of the entrance window area; and low equivalent anode dark current input. It is believed that this tube will meet stipulated specifications. (auth)

35846 (TID-20896) DEVELOPMENT OF A HIGH-SPEED PHOTOMULTIPLIER. Progress Report, October 2, 1963–January 2, 1964. W. W. Sapp and L. D. Owen (Westinghouse Electric Corp. Electronic Tube Div., Elmira, N. Y.). Contract AT(30-1)-2825. 18p.

Multiplier phototube input-cap design modifications are discussed. It is anticipated that a study of these modifications will result in understanding of the possible trade-offs between transit time and dark current in the region between the photocathode and first dynode. Efforts to produce mesh dynodes of consistently high gain reveal that humidity is quite detrimental to these devices. Extended storage times, even in "dry" atmospheres, can reduce the gain by more than 30%. Anticipating a compact design for the mesh section of the tube, several mesh dynodes have been fabricated from 150 line mesh, compared to the 100 line AgMg mesh used in the earlier design. Improvements in techniques and instrumentation are discussed. (auth)

35847 (TID-20917) EQUIVALENCE OF ABSORBED RADIATION ENERGY AND CAVITY IONIZATION. Final 12-Year Report, November 1, 1952–July 31, 1964. John S. Laughlin (Sloan-Kettering Inst. for Cancer Research, New York). July 20, 1964. Contract AT(30-1)-1451. 49p.

Progress is reported in the development of a method of direct measurement of energy fluency and local absorbed dose within an extended medium. The importance of distinguishing and defining these separate quantities is emphasized. The initial development of a calorimetric method for the direct measurement of intensity and energy fluence and the calibration of secondary standards in absolute units are reported. The initial development of a local absorbed-dose microcalorimeter and its use to measure absorbed dose within an extended medium are described. The demonstration of the existence and magnitude of the polarization phenomenon for electrons of relativistic energies and the determination of the "G" value in ions oxidized per 100 ev absorbed for the Fricke ferrous sulfate dosimeter for 10- and 20-Mev electrons which has extended the useful range of this dosimeter are reported. It is demonstrated that there is a significant difference between the depth-dose distribution obtained by cavity ionization measurements and by microcalorimeter local absorbed dose measurement. A portable local absorbed dose microcalorimeter was developed. (C.H.)

35848 (TID-20918) THE DIRECT MEASUREMENT OF LOCAL ABSORBED DOSE PRODUCED BY RADIATION BEAMS IN TISSUE MATERIALS. Annual Progress Report, July 1, 1963–June 30, 1964. John S. Laughlin (Sloan-Kettering Inst. for Cancer Research, New York). July 20, 1964. Contract AT(30-1)-1451. 34p.

The depth-dose distribution for 20-Mev electrons was studies in carbon by calorimetric, film, and ionization methods. Appreciable differences were observed between the absorbed dose and ionization distributions as had been theoretically predicted. These differences are significant for high-energy (more than 4 Mev) radiation therapy. A field calorimeter was completed and calibration is reported to be in progress. An intercomparison of the response of the Fricke dosimeter and several ionization chambers with 20 Mev electrons was made using the carbon calorimeter, and the energy range of the calibration was extended to 35 Mev. Photovoltaic response measurements were made for a lithium-drifted silicon detector of approximately 3 mm intrinsic depth. Observed temperature and nonlinear effects are reported and discussed. Four of a group of newly acquired detectors were mounted in preparation for performance evaluation. (auth)

35849 (TO-B-63-40) ANGULAR DISTRIBUTION OF SKYSHINE RADIATION AT THE SURFACE OF A PLANE OF FALLOUT CONTAMINATION. Albert W. Starbird and John F. Batter (Technical Operations Research, Burlington, Mass.). Mar. 1964. Contract OCD-OS-62-14. 36p. (AD-436311)

An experimental program was conducted to determine the angular distribution of the air-scattered component of gamma radiation (skyshine) at the surface of a plane of fallout contamination. Measurements were made by placing a radiation detector in a vertical collimator recessed flush with the ground surface and placing cobalt-60 sources on the ground along a line extending from the center of the collimator to a radius of about 40 ft to simulate fallout contamination. Detector depth in the collimator was varied to measure skyshine within the cone formed by the collimator opening and the detector at given solid angle fractions for source positions extending from the collimator lip to the 40-ft radius. The experimentally determined results of this program and of other investigators were compared with theoretical calculations. It was concluded that calculated accumulative angular dose rate distributions of skyshine from point and plane sources are probably valid. Analytically derived curves for total scattered radiation for cobalt-60 and cesium-137 underestimate dose rates from close-in sources and slightly underestimate them from distant sources when an earth or asphalt interface is sub-

stituted for free or compressed air values. The analytical equation for calculation of total skyshine is reasonably accurate. (auth)

35850 (ORNL-tr-188) WINDOWLESS PHOTOMULTIPLIERS. M. Brunet, C. Jehanno, C. Julliot, and A. Tarrius. Translated by A. L. Monks (Oak Ridge National Lab., Tenn.), from Onde Elec., 42: 747-53(Sept. 1962). 13p.

A windowless photomultiplier used to detect ions in mass spectrographs, low-energy electrons, or short-wavelength uv photons is described. The dynode material is beryllium bronze containing 2 wt % Be, and is shown to perform well under the high-oxidation conditions. (R.E.U.)

35851 PRELIMINARY STUDY OF CHARACTERISTICS OF PHOTOIONIZATION DETECTOR FOR GAS CHROMATOGRAPHY. Joseph F. Roesler (Robert A. Taft Sanitary Engineering Center, Cincinnati). Anal. Chem., 36: 1900-3 (Sept. 1964).

A photoionization detector was constructed utilizing Kovar metal seals. The glow current was regulated achieving a noise level on the order of 70 $\mu\mu$a. The effects of carrier gas and argon flow rate were observed. Nitrogen and hydrogen were the primary carrier gases used. An extra electrode was incorporated into the detector in an effort to control the standing current. Polarities with respect to the glow discharge were important, affecting the sensitivity and linearity. Thermal effects of the glow discharge were also investigated. A 4.9-cc sample of 2.8 ppm propane in nitrogen gave a maximum response of 660 $\mu\mu$a. (auth)

35852 AVERAGE ENERGY DISTRIBUTION OF BETA RADIATION OF LOW-ACTIVITY SAMPLES. S. V. Belov and A. P. Bychkov. At. Energ. (USSR), 16: 518(June 1964). (In Russian)

A method for measuring the average energy of beta emission for samples with activities of the order of 1000 dpm with errors not greater than 5 to 10% is described. A photomultiplier with an anthracene crystal and a 100-channel pulse amplitude analyzer are used for the beta spectrometer. The counting efficiency as a function of beta energy and the relation between true and counter average energy values are presented. The variation of counter accuracy with sample thickness is discussed. (M.J.T.)

35853 STUDY OF ACCUMULATION OF ^{239}Pu BY THE GAMMA EMISSION OF ^{239}U. L. N. Yurova and A. V. Bushuev. At. Energ. (USSR), 16: 527(June 1964). (In Russian)

The usual methods of measuring the accumulation of ^{239}Pu in the chain $n + {}^{238}U \rightarrow {}^{239}U \xrightarrow{\beta,\gamma} {}^{239}Np \xrightarrow{\beta,\gamma} {}^{239}Pu$ are based on recording the beta emission from ^{239}U or ^{239}Np or the gamma emission of ^{239}Np. It is shown that a method using ^{239}U gamma rays is significantly better. This method was tested in measurements on fast critical assemblies. The apparatus consisted of a scintillation gamma spectrometer with a NaI(Tl) crystal and a single-channel amplitude analyzer. 100% efficiency in recording ^{239}U gamma rays was obtained. The dependence of the amplitudes of the pulses on the radiation energy was linear within 1% for energies from 40 kev to 2.75 Mev. Statistical error was 0.5% for measurements in an integral current of 2×10^8 n/cm^2. (M.J.T.)

35854 CARE AND MAINTENANCE OF NUCLEAR INSTRUMENTS. PART II. Carl L. Henry. Atomics, 17: No. 4, 38-41(July-Aug. 1964).

The care and maintenance of dynamic electrometers, scalers, rate meters, and counting devices are discussed. (C.E.S.)

35855 AGE DETERMINATION WITH THE LIQUID SCINTILLATION SPECTROMETER: EFFECTIVENESS OF SCREENING MEASURES. F. Pietig and H. W. Scharpenseel (Universität, Bonn). Atompraxis, 10: 306-8(July 1964). (In German)

A systematic investigation was made on the range of background reduction by shielding. When full shielding (borax shielding included) was applied a quartz vial with 40 ml of dead benzene + 5% PPO as scintillator between two multipliers with quartz windows showed a background of: without anticoincidence 4.64 cpm (counts/min); with anticoincidence 3.51 cpm (counts/min). With anticoincidence a background reduction of 24.4% was obtained. In the same adjustment of the instrument with active samples a yield of ~50% was measured. Attempts to take PBD instead of PPO showed no better yields in the same adjustment. (auth)

35856 A COMPARISON OF THE ENERGY DEPENDENCE OF THE DOSE SENSITIVITY OF IONIZATION DETECTORS IN THE TRIGGER AND PROPORTIONAL REGION FOR X-RAYS AND GAMMA RAYS. K.-H. Weber (VEB Vakutronik WIB, Dresden). Atompraxis, 10: 308-14 (July 1964). (In German)

The dose sensitivity of ionization chambers for x and gamma rays in relation to quantum energy was calculated for various wall materials, wall thicknesses, filling gases, and filling pressures. In regard to the energy dependence of the sensitivity, a distinction must be made between detectors whose sensitivity is proportional to the number of secondary electrons entering the ionization volume, and detectors whose sensitivity is dependent upon the energy absorbed in the ionization volume. For both cases the energy dependence of the dose sensitivity in the range from 10 kev to 1.5 Mev was compared, and measures for decreasing the energy dependence are discussed. (auth)

35857 ACCURACY AND REPRODUCIBILITY OF COUNTING RATES. II. MEASUREMENTS WITH METHANE-FLOWCOUNTERS. H. Erbe (Telefunken AG, Ulm, Ger.). Atompraxis, 10: 320-3(July 1964). (In German)

The counting characteristics of a methane flowcounter were studied for various β-active samples. Changes in the performance of the counter with time are considered. Deviations of the counting rate from the mean value are discussed. Part of the nonstatistical deviation was explained by effects of temperature and atmospheric pressure. (M.J.T.)

35858 METHODS AND TECHNIQUES FOR MEASURING THE RADIOACTIVITY IN WATER AND WASTE WATER. J. Bosch. Ber. Abwassertech. Ver., No. 11, 20-33 (1960). (In German)

Methods and instruments used for the measurement of the concentrations of radioactivity in water and waste water are described. The fundamental factors in radioactivity measurements are presented, and a formula for the relation between radioactivity concentration and measurement device readings is derived. The formula is used in the description of practical measurement set-ups. The G-M counter tube, other counter tube instruments, methane flow-through counters, scintillation counters, and special devices for the measurement of the water activity are discussed individually. (J.S.R.)

35859 THE PULSE-HEIGHT DISTRIBUTION IN N.E. 102 SCINTILLATOR FOR MONOENERGETIC NEUTRONS. D. R. Christie, J. M. Daniels, and H. A. Farach. Can. J. Phys., 42: 1676-79(Aug. 1964).

Monoenergetic neutrons were produced by bombarding a thick heavy-ice target with deuterons, usually with an

energy no greater than 50 kev in order to obtain an empirical determination of the pulse-height distribution in the range 2 to 3 Mev. The value of the neutron energy was measured as 2.435 Mev. (F.S.A.)

35860 CERTAIN RESULTS FROM THE STUDY OF CORONA COUNTERS OF NEUTRONS AND THEIR USE IN REACTOR MEASUREMENTS. V. Khristov, D. Damyanov, and N. Buchvarov. Izv. Fiz. Inst. s Aneb, Bulgar. Akad. Nauk. 10: No. 2, 37-45(1962). (In Russian)

Corona counters of neutrons with different shapes of the electrodes and filled with pure argon were constructed. It is shown that a stable corona and a good working plateau may be obtained by the appropriate selection of charge resistances and argon pressure. Empiric correlations were established between the corona and the working characteristics of the counters. A long cylindrical corona counter was used as a detector of the constructed all-wave neutron counter, with the help of which the effectiveness of the biological shielding of the IRT-1000 Reactor was measured. (auth)

35861 THERMAL AND FAST NEUTRON DETECTION BY FISSION-TRACK PRODUCTION IN MICA. P. R. Prevo, R. E. Dahl, and H. H. Yoshikawa (General Electric Co., Richland, Wash.). J. Appl. Phys., 35: 2636-8(Sept. 1964). (HW-SA-3265)

The recently developed method of etching fission fragment tracks in mica appears to be applicable to the measurement of neutron exposures in irradiation tests. The sensitivity of the method depends on the concentration of fissile elements. The naturally occurring uranium which is present in trace quantity can be used to measure thermal neutron exposures of 10^{16} to 10^{21} neutrons/cm^2. Deposition of fissionable material on the mica would increase the sensitivity to permit measurement of 10^6 to 10^{11} neutrons/cm^2. Density counts are reproducible to approximately 5% by using simple laboratory techniques. (auth)

35862 THE USE OF A WINDOWLESS GAS-FLOW COUNTER FOR DETECTING WEAK β EMITTERS ON PAPER CHROMATOGRAMS. Horace E. Dobbs (Atomic Energy Research Establishment, Wantage, Berks, Eng.). J. Chromatog., 15: 29-38(June 1964).

A 2π gas flow proportional counter for scanning chromatograms is described. The effects of the gas flow rate, build up of static charge, and the volatilization of the sample on the reproducibility of scans are discussed and methods whereby artefacts due to these causes can be minimized are outlined. It is shown that different scans can be obtained from opposite faces of the same chromatogram. It is also shown that when using tritium the peak height, or peak area, on a scan does not necessarily correspond with the activity of the spot on the chromatogram for different substances. Thus a spot containing 1.2 μC of tritiated stearic acid produces a peak on the scan with an area four times greater than that produced by a spot containing 2.2 μC of tritiated benzoic acid on the same chromatogram. An operational procedure based on these findings is outlined. (auth)

35863 AN ITERATIVE UNFOLDING PROCEDURE. Ronald P. Uhlig (Univ. of Maryland, College Park). J. Res. Natl. Bur. Std., 68A: 401-7(July-Aug. 1964).

An iterative procedure for unfolding the effects of the finite resolution of a detector from an observed pulse height distribution is discussed. The process is demonstrated for a particular detection system. Convergence and uniqueness properties of the method are discussed empirically. A general expression for the propagated error resulting from errors in the detected pulse height distribution is derived. Approximations are made in order to evaluate the propagated error for a particular detector. The approximations become better as the resolution of the detector improves. The results indicate that the error rapidly approaches a limit of from 1.5 to 3 times the error in the observed distribution. This limit is reached in approximately three iterations. (auth)

35864 USE OF TUNNEL DIODES IN FAST AMPLITUDE DISCRIMINATORS. Bohumil Sojka (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Rez). Jaderna Energie, 10: 217-20(June 1964). (In Czech)

A survey is made of fast amplitude discriminators using tunnel diodes as flip-flop circuits. They are suitable for scintillation counters with less than 50 ohms. All information is based on foreign literature. Seven references. (OTS)

35865 RADIOMETRIC CALORIMETRY: A REVIEW. S. R. Gunn (Univ. of California, Livermore). Nucl. Instr. Methods, 29: 1-24(Sept. 1964). (UCRL-7636)

Calorimetric applications and instrumentation in nuclear science and technology are reviewed, primarily for the period since 1949. Principles of calorimetry are discussed; applications are categorized as measurement of radionuclides, gamma or particle beams, local absorbed dose from gamma fields and reactor radiations. 211 references. (auth)

35866 SYSTEM FOR AUTOMATICALLY PUNCHING ONTO IBM CARDS THE OUTPUT OF A 400-CHANNEL PULSE HEIGHT ANALYZER. B. Greenebaum (Harvard Univ., Cambridge, Mass.). Nucl. Instr. Methods, 29: 25-8 (Sept. 1964).

The output typewriter drive of the RIDL 400-channel pulse height analyzer system was adapted to drive the IBM Model 526 card punch without impairing any of the analyzer systems standard features. The card punch operates at close to maximum speed, stepping the analyzer along digit-by-digit by briefly closing the analyzer interlock. The analyzer "print" signal controls the starting and stopping of the punch exactly as in a typewriter readout. One 400-channel spectrum is punched onto 40 complete cards, which are also numbered serially and punched with an identifying tag, in approximately 3.5 min. (auth)

35867 A TRANSISTORIZED "FAST-SLOW" COINCIDENCE APPARATUS WITH FAST SINGLE CHANNEL DISCRIMINATORS. K.-H. Van Heek, H.-D. Schilling, and L. Wallek (Universität, Münster, Ger.). Nucl. Instr. Methods, 29: 35-9(Sept. 1964). (In German)

A fully transistorized fast-slow coincidence apparatus is described in which the single-channel discriminators have a short dead time (140 nsec) and can operate with short input pulse lengths (about 20 nsec), as well as with NaI-pulses (several μsec). Pulse heights from 0.14 to 2.14 v (negative pulses) or from 0.28 to 4 v (positive pulses) can be analyzed. The stability of the channel position is better than 0.1% with a temperature coefficient of about 0.03%/°C. The resolving time of the fast coincidence is $2\tau = 4$ nsec for scintillation pulses. (auth)

35868 THE USE OF AN ELECTROLUMINESCENT IMAGE-INTENSIFIER PANEL IN DETECTING BEAMS OF NUCLEAR PARTICLES. P. Iredale and G. W. Hinder (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nucl. Instr. Methods, 29: 43-4(Sept. 1964). (AERE-R-4479)

A solid-state image-intensifier consisting of adjacent layers of photoconductive and electroluminescent material was used to detect a beam of nuclear particles. The de-

vice, when viewed by a vidicon television camera tube, has a threshold of $\sim 8 \times 10^8$ minimum ionizing particles/cm^2·sec. (auth)

35869 ANALYSIS BY SAMPLING OF INDIVIDUAL PHOTONS OF LIQUID SCINTILLATORS IN THE SUBNANOSECOND REGION. Y. Koechlin and A. Raviart (Centre d'Etudes Nucléaires, Saclay, France). Nucl. Instr. Methods, 29: 45-53(Sept. 1964). (In French)

A sampling method involving the time emission measurement of individual photons in short light pulses is described, and scintillation shape measurements of several organic liquid scintillators under alpha, beta, and gamma excitation are reported. The lifetimes at excited states determined for some solvent and solute molecules agree favorably with the results obtained by other methods: 1.7 nsec for PBD and 2.4 nsec for p-terphenyl. Moreover, very short life times were found: 0.5 nsec for POPOP. Scintillation shape studies show a process of non-radiative energy transfer from solvent to solute according to the concentration dependence. (auth)

35870 AN ELECTRON SPECTROGRAPH WITH PRE-ACCELERATION THE LOW-ENERGY CONVERSION AND AUGER ELECTRON SPECTRA OF Pa^{233}. R. G. Albridge (Univ. of California, Berkeley). Nucl. Instr. Methods, 29: 61-5(Sept. 1964).

A permanent magnet electron spectrograph was constructed for the detection of low-energy conversion and Auger electrons. The instrument uses the technique of pre-acceleration and was used to record electrons with energies of less than 1 kev. (auth)

35871 PULSE FORMATION AND TRANSIT TIME OF CHARGE CARRIERS IN SEMICONDUCTOR JUNCTION DETECTORS. P. A. Tove and K. Falk (Uppsala Univ.). Nucl. Instr. Methods, 29: 66-8(Sept. 1964).

The formation and shape of the current pulse in semiconductor detectors are discussed theoretically. The transit time of released charge carriers and the resulting pulse rise time is calculated for n- and p-type junction detectors under the simplifying assumption of constant carrier mobilities and specific ionization loss and with neglection of eventual plasma effects. Expressions are given for the rise time, and the results are also shown in nomogram form. (auth)

35872 EXTENDING A MULTICHANNEL ANALYZER FOR TWO PARAMETER PULSE HEIGHT ANALYSIS. M. G. Strauss (Argonne National Lab., Ill.). Nucl. Instr. Methods, 29: 69-76(Sept. 1964).

A system is described which extends the utility of a 400- or 512-channel analyzer from a single parameter to a two-parameter, pulse-height analyzer. A two-parameter selector is used which selects the coincident events to be measured and the memory subgroup to store them. It consists basically of a fast-slow coincidence circuit, an analog-to-digital convertor, and four digital windows. The two-parameter system operates in both coincidence and non-coincidence modes. (auth)

35873 THE DETECTION EFFICIENCY OF A PLASTIC SCINTILLATOR FOR NEUTRONS IN THE ENERGY RANGE OF 21-29 Mev. G. Gatti, P. Hillman, W. C. Middelkoop, T. Yamagata, and E. Zavattini (CERN, Geneva). Nucl. Instr. Methods, 29: 77-82(Sept. 1964).

A method of calibrating the efficiency of a high-energy neutron detector is described. Results are given for a plastic scintillator block in the region from 21 to 29 Mev. Comparison with results from other laboratories shows that, with a proton energy detection threshold of about 4 Mev and for linear dimensions slightly less than the range of the maximum energy protons, the efficiency is rather independent of the size or shape of the scintillator and equal to nearly 2%/cm thickness in the range from 10 to 30 Mev. (auth)

35874 HIGH RESOLUTION ALPHA PARTICLE SPECTROSCOPY AT VERY LOW SPECIFIC ACTIVITIES. R. V. Osborne and C. R. Hill (Inst. of Cancer Research, Belmont, Surrey, Eng.). Nucl. Instr. Methods, 29: 101-6(Sept. 1964).

An alpha particle spectrometer which is suitable for use with materials of very low specific activities (the order of 10^{-12} C/g) and which provides a resolution of 50 kev is described. The instrument is a pulse ionisation chamber with a gridded cylindrical electrode arrangement, providing a source area of 1500 cm^2. For convenience in dealing with small, "weightless" sources, a four-position, conventional parallel plate gridded electrode system is available as an alternative to the cylindrical arrangement, using the small gas chamber and electronic system. (auth)

35875 A SYSTEM FOR STABILIZING THE SCINTILLATION SPECTROMETER. F. Stenman (Univ. of Helsinki). Nucl. Instr. Methods, 29: 107-8(Sept. 1964).

A system for stabilizing the gain of a gamma scintillation spectrometer is described. The system uses as a reference signal the counting rate from a window discriminator set on a negative slope in the spectrum. A stabilization factor of 120 and a 21-hr stability of ±0.2% were obtained. The system does not require any modifications in the amplifier system to be stabilized. (auth)

35876 A NEW TYPE OF MICROPHONE FOR USE IN ACOUSTIC SPARK CHAMBERS. B. D. Jones (Univ. of Bristol, Eng.), J. Malos, W. Galbraith, and G. Manning. Nucl. Instr. Methods, 29: 115-20(Sept. 1964).

Electrostatic and piezoelectric microphones in which the sensitive element was a long narrow strip were constructed and tested with sparks in air. With a system of four piezoelectric units, spark positions in a chamber were determined with estimated standard deviations of 0.03 cm without prior knowledge of the velocity of sound in the gas. (D.C.W.)

35877 A ČERENKOV SHOWER COUNTER. C. A. Heusch and C. Y. Prescott (California Inst. of Tech., Pasadena). Nucl. Instr. Methods, 29: 125-30(Sept. 1964).

A counter for fast identification of high-energy electrons and photons in heavy backgrounds is described, consisting of successive layers of lead and lucite. Cherenkov radiation emitted in the lucite slabs is collected on the photocathode of a 5-in. phototube. For an incoming momentum of 1 Bev/c, 99% of all mesons(π) and (μ) can be rejected, while losing only 1% of the electrons and photons. The response over the face of the counter is uniform. (D.C.W.)

35878 A TIME-TO-PULSE-HEIGHT CONVERTER WITH SIMULTANEOUS RANDOM COINCIDENCE SUBTRACTION. A. E. Blaugrund and Z. Vager (Weizmann Inst. of Science, Rehovoth, Israel). Nucl. Instr. Methods, 29: 131-6(Sept. 1964).

A coincidence circuit capable of simultaneous registration or subtraction of random coincidences is described, which is based on a time-to-pulse-height converter. A time-to-pulse-height converter for use with NaI(Tl) scintillation counters is also described. Random coincidences are counted during the coincidence experiment. Systematic errors in determining the number of random coincidences are smaller than 0.5%. The resolving time of the system is 6 nsec for the 0.51 Mev line of ^{22}Na. The circuit performs satisfactorily at counting rates up to 50,000/sec. (auth)

35879 A FAST COINCIDENCE CIRCUIT USING ZERO-CROSSED PHOTOMULTIPLIER PULSES. J. Garvey (Univ. of Glasgow). Nucl. Instr. Methods, 29: 137-40(Sept. 1964).

A coincidence circuit is described which may be used for accurate timing measurements in experiments involving scintillation counters. The circuit is operated by standard pulses generated by the crossover point of zero-crossed photomultiplier pulses. The accuracy of the timing information extracted from photomultiplier pulses with a large range of amplitude is given, together with the performance of the circuit for two large scintillation counters. (auth)

35880 ELECTRONIC DESIGN OF AN ABSOLUTE COUNTING SYSTEM FOR Mn^{56}. K. G. A. Porges, A. Devolpi, and R. N. Larsen (Argonne National Lab., Ill.). Nucl. Instr. Methods, 29: 157-69(Sept. 1964).

A two-stage system for precise counting of weakly activated solutions of $^{56}MnSO_4$ drawn from an integrating neutron detector of the manganese bath type is described. Two liter aqueous solutions are counted directly in a γ-γ coincidence arrangement which is calibrated by counting small aliquots of strongly activated samples mixed with liquid scintillator in a β-γ system. (D.C.W.)

35881 ON THE CALCULATION OF THE FORM OF SCINTILLATION COUNTER PULSES. H. Jungclaussen (Zentralinstitut für Kernforschung, Rossendorf, Ger.). Nucl. Instr. Methods, 29: 169-71(Sept. 1964). (In German)

Some formulas for the theoretical treatment of the electronic handling of pulses in a scintillation counter are derived. An effective bandwidth of the photomultiplier is given. (auth)

35882 ON THE SPEED OF PROPAGATION OF THE DISCHARGE ALONG THE WIRE OF GEIGER-MÜLLER COUNTERS, AT HIGH OVER VOLTAGES. V. Bogui (Faculté des Sciences, Toulouse). Nucl. Instr. Methods, 29: 172(Sept. 1964). (In French)

The propagation rate was investigated using a long detector, the cylinder of which comprised four sections 9-cm long separated by paraffin rings 2.5-cm thick. One of the end sections was exposed to beta particles, and the propagation rate was obtained from coincidences between the sections. (D.C.W.)

35883 A SELF-TRIGGERING SPARK CHAMBER. S. Yasumi (Kyoto Univ.), H. Itoh, A. Masaike, and K. Miyake. Nucl. Instr. Methods, 29: 173-4(Sept. 1964).

A spark chamber that is triggered by the scintillation pulse produced by the passage of ionizing particles in the chamber gas is described. (D.C.W.)

35884 A RUGGED NUCLEAR PARTICLE DETECTOR WITH IMPROVED STABILITY. R. L. Williams and C. D. Wilburn (Simtec Ltd., Montreal). Nucl. Instr. Methods, 29: 175-6(Sept. 1964).

A deep depletion layer diode formed by diffusing Li into a restricted portion of a Si wafer and then drifting Li completely through the wafer to a p^+, B-diffused surface layer about 0.2-μ thick is discussed. An ^{241}Am alpha spectrum obtained with such a diode is included. (D.C.W.)

35885 THE TUNNEL DIODE IN NUCLEAR INSTRUMENTATION. Luigi D'Angola. Rivoluzione Ind., No. 136, 49-51(Apr. 1964). (In Italian)

The operation of the tunnel diode is described, and the equivalent circuit and the cut-off frequency of a tunnel diode are illustrated. The use of tunnel diodes in switching circuits, astable multivibrators, monostable multivibrators, bistable multivibrators, and amplitude discriminators is described. (J.S.R.)

35886 TELESCOPE FOR THE INVESTIGATION OF NUCLEAR REACTIONS. I. B. Teplov, V. S. Zazulin, and L. N. Fateeva. Vestn. Mosk. Univ., Ser. III, Fiz. Astron., No. 6, 3-12(Nov.-Dec. 1963). (In Russian)

Descriptions are given of a telescope with four proportional counters for measuring the energy and angular distributions of nuclear reaction products. The telescope is capable of recording particles at angles from 10 to 162°. The telescope was used in analyses of the spectra of protons and α particles elastically scattered on gold and of α particles scattered on lawsonite. The energy spectrum for protons from $^{12}C(\alpha,p)^{15}N$ reactions was also analyzed. (R.V.J.)

35887 ALPHA PARTICLE DETECTION TECHNIQUES APPLICABLE TO THE MEASUREMENT OF SAMPLES FROM THE NATURAL RADIATION ENVIRONMENT. R. D. Cherry (Univ. of Cape Town). p.407-24 of "The Natural Radiation Environment." Chicago, University of Chicago Press, 1964.

A review is presented of α detection techniques which can be used in studies of natural environmental samples. Total α counting and spectroscopic techniques are described. Some of the topics considered are the pairs technique, the range problem, the homogeneity problem, gaseous samples, ion chambers, scintillation spectrometers, semiconductor detectors, nuclear emulsions, etc. The natural α activity of materials in the construction of α detectors and counting statistics are discussed briefly. A bibliography is given. (D.L.C.)

35888 LABORATORY γ-RAY SPECTROMETER FOR GEOCHEMICAL STUDIES. J. A. S. Adams (Rice Univ., Houston, Tex.). p.485-97 of "The Natural Radiation Environment." Chicago, University of Chicago Press, 1964.

A description is given of the γ pulse-height or spectrometric techniques used for five years in the determination of Th, U, and K at the levels of concentration found in common terrestrial materials. Shielding, instrumentation, spectrum analysis, sample preparation, and standards are discussed. (D.L.C.)

35889 PORTABLE γ-RAY SPECTROMETER FOR FIELD DETERMINATION OF THORIUM, URANIUM, AND POTASSIUM. J. A. S. Adams and G. E. Fryer (Rice Univ., Houston, Tex.). p.577-96 of "The Natural Radiation Environment." Chicago, University of Chicago Press, 1964.

Experience in the design, construction, and field use of portable γ-ray spectrometers for Th, U, and K determinations is summarized. Field measurements have the advantage of being able to develop quickly the most effective sampling patterns and density. Among the items discussed are the shielding, detector, amplifier, discriminators, anticoincidence circuit, scaler, and power supply. Instrument drift, calibration, and field procedures are described. (D.L.C.)

35890 COMPUTER TECHNIQUES IN γ SPECTROMETRY. Phillip N. Dean (Los Alamos Scientific Lab., N. Mex.). p.617-26 of "The Natural Radiation Environment." Chicago, University of Chicago Press, 1964.

Computer codes used in γ spectrometry are of two types: qualitative (identification of photopeaks) and quantitative (determination of absolute amounts of each component). Examples of the application of the two code types in spectrum analysis are given. (D.L.C.)

35891 MEASUREMENT OF ENVIRONMENTAL RADIATION WITH PLASTIC SCINTILLATORS. A. Wensel (Johann Wolfgang Goethe Universität, Frankfurt am Main). p.643-54

of "The Natural Radiation Environment." Chicago, University of Chicago Press, 1964.

Car-borne equipment is needed for a survey of radiation levels around a reactor station. A large plastic scintillation counter with a 4-discriminator pulse integrator is suitable for this application. The counter can be made energy independent, and operation in a moving car is possible. (D.L.C.)

35892 INSTRUMENTATION FOR AERIAL SURVEYS OF TERRESTRIAL γ RADIATION. John E. Hand (Edgerton, Germeshausen and Grier, Inc., Goleta, Calif.). p.687-704 of "The Natural Radiation Environment." Chicago, University of Chicago Press, 1964.

The instrumentation for the Aerial Radiological Measuring Surveys (ARMS) is described. The aircraft position subsystem and data recording subsystem are discussed. The instrumentation was installed in a light airplane and successfully operated for two years. The detection range is 50 cps to 10^7 cps at 500 ft above terrain. Uncertainties in the collected data are discussed. (D.L.C.)

35893 THE BRITISH UNIVERSITIES' EAS PROJECT AT HAVERAH PARK. J. G. Wilson, H. R. Allen, S. C. Lillicrap, R. J. O. Reid, and K. E. Turver. p.27-34 of "International Conference on Cosmic Rays. Vol. 4." Bombay, Tata Inst. of Fundamental Research, 1964.

Instrumentation for the investigation of extensive air showers is described. (C.E.S.)

35894 CHEMICAL DOSIMETRY OF HYDROCARBONS AND RADIATION SENSITIVITY OF CHLORINATED HYDROCARBONS IN AQUEOUS SOLUTIONS. P. Tschichold. Thesis, Basel, Universität, 1961. 101p. $2.00 (Gmelin, AED-DISS. 61-367). (In German)

The G-value of a ferrosulfate dosimeter was determined using a ^{60}Co source. A value of 16.0 was found. Based on this value the dose constant of ^{192}Ir was determined by chemical methods. Results are in agreement with calculations using the decay scheme. Various chlorinated hydrocarbons were irradiated with a ^{60}Co source. It was found that only S-free compounds follow the laws of the chemical electron theory. (Gmelin Inst.)

35895 PORTABLE AIR SAMPLER (Engineering Materials). (California. Univ., Berkeley. Lawrence Radiation Lab.). (CAPE-573)

Drawings (34) are included for the sampler, also known as the Giraffe Air Sampler, which is an improved design of a Los Alamos sampler. It may be used in offices and other quiet areas. This improved design has a constant air flow of of 1 cfm. An oil-lubricated pump with a recirculating oiling system, which is easy to maintain, is used to replace the dry-type vacuum pump used previously. Running time meters make sampling record-keeping simpler. For a listing of individual titles, see the Engineering Materials List (TID-4100). (C.E.S.)

35896 A NEW METHOD FOR COLOR-SCANNING. H. Kakehi, N. Arimizu, G. Uchiyama, H. Genta, and S. Kubo (Chiba Univ., Japan). Vienna, International Atomic Energy Agency, 1964, Preprint SM-51/7, 10p. (CONF-453-7)

From IAEA Symposium on Medical Radioisotope Scanning, Athens, Apr. 1964.

A new method for color-scanning is described that uses an electronic gating circuit in place of a rate meter. Ten gates intercept the signals from the detector and at any one time only one of these is opened, depending on the number of counts recorded in a fixed time. Each gate actuates a chosen color filter which filters the light from a xenon discharge tube. The filtered light is then used to form a photographic picture. Color printing papers are used to obtain scintigrams of natural size of organs. The movement of the color filter rapidly follows changes in counting rate. Image distortion is thus avoided and scanning time is reduced. Clinical results with the system are presented for the thyroid gland and liver after the administration of ^{131}I- and the pancreas after administration of ^{75}Se-methionine. (C.H.)

35897 CONTRAST ENHANCEMENT BY MULTICOLOR PRINT-OUT OF THYROID, KIDNEY, LIVER AND BRAIN SCANS. G. J. Hine, D. H. Patten, and B. A. Burrows (Veterans Administration Hospital, Boston and Univ. of Boston). Vienna, International Atomic Energy Agency, 1964, Preprint SM-51/57, 8p. (CONF-453-8)

Fram IAEA Symposium on Medical Radioisotope Scanning, Athens, Apr. 1964.

Quantitative information can be obtained from a scan if the color of the print-out changes with the count-rate. The printing pattern shows then the radioisotope distribution and the printing color serves as a code for a digital evaluation of the scan. This can delineate areas with small differences in count-rate more clearly than other read-out methods. A system is described in which a stylus hits one of several colored typewriter ribbons mounted on a common carriage. Its movement is controlled by a count-rate meter with a time constant of 0.3 sec. The first ribbon covering the lowest count-rate interval is uninked. This suppresses colored prints at count-rates of less than 12.5% of the 100% maximum adjusted for each scan when eight colored ribbons are used. However, all counts are preserved in black on carbon copies. The clinical advantage of the color scan is to recognize immediately differences in count-rate which outline areas of varying radioisotope concentration. The color cut-off at low count-rates yields an improved visualization of areas such as brain lesions, which are difficult to localize due to high tissue background. The color scan outlines the contours corresponding to the thickness of functioning liver tissue which are not easily seen otherwise. Compared with normal liver scans, areas of fibrosis and tumor infiltration are more readily recognized. The same is true for kidney scans where a change in color may indicate ischemic, cystic or tumor areas. For thyroid scans, the color print-out provides semi-quantitative comparison of radioiodine uptake in different areas. (auth)

35898 SCINTILLATION DETECTOR. Donald George Ludlum (to Eberline Instrument Corp.). British Patent 965,097. July 29, 1964. Filed Mar. 22, 1961.

A detailed description is given of a scintillation detector which can count alpha particles over a wide range with extreme accuracy, which withstands rough usage and wide variations in temperature, and which has a long useful life with minimum upkeep. (D.L.C.)

35899 LUMINESCENT APPARATUS FOR DETERMINING IONISING RADIATION DOSAGES. (to Manufacture Belge de Lampes et de Materiel Electronique). British Patent 965,227. July 29, 1964. Priority date Sept. 15, 1959, Belgium.

An apparatus is designed for determining radiation dosages by means of measurements of the luminous energy liberated on the heating of a irradiated thermoluminescent substance. The apparatus comprises a nickel tube coated with a thermoluminescent substance (CaF_2) using a vitrifiable enamel as binder, a heating element near the tube, and an opaque casing housing both the tube and heating element and having a thin lead layer 0,7 mm thick. This lead

layer results in a substantially linear response for energies of 0.1 to 1.25 Mev. (D.L.C.)

35900 IMPROVEMENTS IN OR RELATING TO THE MEASUREMENT OF RADIOACTIVE DECAY RATES. Alasdair MacKenzie, William Fraser Mackie Deans, Eustace Lionel Ernest Harrington, and Neil MacKinlay Sutherland (to United Kingdom Atomic Energy Authority). British Patent 965,334. July 29, 1964. Filed Apr. 4, 1962.

An apparatus is designed for the automatic measurement of the radioactivity of samples without preliminary determination of the level of the radioactivity. The apparatus comprises a sample chamber, a radiation measuring device for providing an electrical output with a magnitude proportional to the radioactivity, an electrical storage means, a timing means for causing after a predetermined delay the storage of the electrical value, comparison means for comparing the stored value with the succeeding output of the measuring device, and means for indicating the relationship between the stored value and the succeeding output. (D.L.C.)

35901 DUAL SENSOR GAMMA RAY CALORIMETER. James R. Coss, Maurice J. Cote, and Philip B. Hemmig (to U. S. Air Force). U. S. Patent 3,145,300. Aug. 18, 1964. Filed Mar. 7, 1961.

A gamma-ray dosimeter of the calorimeter type is designed for the measurement of dose rates above 10^7 ergs/g. The dosimeter comprises two cylindrical spaced bodies of dissimilar materials, e.g., carbon and lead, joined by a soft iron rod and located inside a thermal radiation buffer such as an aluminum shell. A thermocouple is located in each body, and the differential voltage produced between the thermocouples on exposure of the bodies to gamma radiation is taken to be a measure of the dose rate. (D.L.C.)

of "The Natural Radiation Environment." Chicago, University of Chicago Press, 1964.

Car-borne equipment is needed for a survey of radiation levels around a reactor station. A large plastic scintillation counter with a 4-discriminator pulse integrator is suitable for this application. The counter can be made energy independent, and operation in a moving car is possible. (D.L.C.)

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The G-value of a ferrosulfate dosimeter was determined using a ^{60}Co source. A value of 16.0 was found. Based on this value the dose constant of ^{192}Ir was determined by chemical methods. Results are in agreement with calculations using the decay scheme. Various chlorinated hydrocarbons were irradiated with a ^{60}Co source. It was found that only S-free compounds follow the laws of the chemical electron theory. (Gmelin Inst.)

35895 PORTABLE AIR SAMPLER (Engineering Materials). (California. Univ., Berkeley. Lawrence Radiation Lab.). (CAPE-573)

Drawings (34) are included for the sampler, also known as the Giraffe Air Sampler, which is an improved design of a Los Alamos sampler. It may be used in offices and other quiet areas. This improved design has a constant air flow of of 1 cfm. An oil-lubricated pump with a recirculating oiling system, which is easy to maintain, is used to replace the dry-type vacuum pump used previously. Running time meters make sampling record-keeping simpler. For a listing of individual titles, see the Engineering Materials List (TID-4100). (C.E.S.)

35896 A NEW METHOD FOR COLOR-SCANNING. H. Kakehi, N. Arimizu, G. Uchiyama, H. Genta, and S. Kubo (Chiba Univ., Japan). Vienna, International Atomic Energy Agency, 1964, Preprint SM-51/7, 10p. (CONF-453-7)

From IAEA Symposium on Medical Radioisotope Scanning, Athens, Apr. 1964.

A new method for color-scanning is described that uses an electronic gating circuit in place of a rate meter. Ten gates intercept the signals from the detector and at any one time only one of these is opened, depending on the number of counts recorded in a fixed time. Each gate actuates a chosen color filter which filters the light from a xenon discharge tube. The filtered light is then used to form a photographic picture. Color printing papers are used to obtain scintigrams of natural size of organs. The movement of the color filter rapidly follows changes in counting rate. Image distortion is thus avoided and scanning time is reduced. Clinical results with the system are presented for the thyroid gland and liver after the administration of ^{131}I- and the pancreas after administration of ^{75}Se-methionine. (C.H.)

35897 CONTRAST ENHANCEMENT BY MULTICOLOR PRINT-OUT OF THYROID, KIDNEY, LIVER AND BRAIN SCANS. G. J. Hine, D. H. Patten, and B. A. Burrows (Veterans Administration Hospital, Boston and Univ. of Boston). Vienna, International Atomic Energy Agency, 1964, Preprint SM-51/57, 8p. (CONF-453-8)

Fram IAEA Symposium on Medical Radioisotope Scanning, Athens, Apr. 1964.

Quantitative information can be obtained from a scan if the color of the print-out changes with the count-rate. The printing pattern shows then the radioisotope distribution and the printing color serves as a code for a digital evaluation of the scan. This can delineate areas with small differences in count-rate more clearly than other read-out methods. A system is described in which a stylus hits one of several colored typewriter ribbons mounted on a common carriage. Its movement is controlled by a count-rate meter with a time constant of 0.3 sec. The first ribbon covering the lowest count-rate interval is uninked. This suppresses colored prints at count-rates of less than 12.5% of the 100% maximum adjusted for each scan when eight colored ribbons are used. However, all counts are preserved in black on carbon copies. The clinical advantage of the color scan is to recognize immediately differences in count-rate which outline areas of varying radioisotope concentration. The color cut-off at low count-rates yields an improved visualization of areas such as brain lesions, which are difficult to localize due to high tissue background. The color scan outlines the contours corresponding to the thickness of functioning liver tissue which are not easily seen otherwise. Compared with normal liver scans, areas of fibrosis and tumor infiltration are more readily recognized. The same is true for kidney scans where a change in color may indicate ischemic, cystic or tumor areas. For thyroid scans, the color print-out provides semi-quantitative comparison of radioiodine uptake in different areas. (auth)

35898 SCINTILLATION DETECTOR. Donald George Ludlum (to Eberline Instrument Corp.). British Patent 965,097. July 29, 1964. Filed Mar. 22, 1961.

A detailed description is given of a scintillation detector which can count alpha particles over a wide range with extreme accuracy, which withstands rough usage and wide variations in temperature, and which has a long useful life with minimum upkeep. (D.L.C.)

35899 LUMINESCENT APPARATUS FOR DETERMINING IONISING RADIATION DOSAGES. (to Manufacture Belge de Lampes et de Materiel Electronique). British Patent 965,227. July 29, 1964. Priority date Sept. 15, 1959, Belgium.

An apparatus is designed for determining radiation dosages by means of measurements of the luminous energy liberated on the heating of a irradiated thermoluminescent substance. The apparatus comprises a nickel tube coated with a thermoluminescent substance (CaF_2) using a vitrifiable enamel as binder, a heating element near the tube, and an opaque casing housing both the tube and heating element and having a thin lead layer 0.7 mm thick. This lead

layer results in a substantially linear response for energies of 0.1 to 1.25 Mev. (D.L.C.)

35900 IMPROVEMENTS IN OR RELATING TO THE MEASUREMENT OF RADIOACTIVE DECAY RATES. Alasdair MacKenzie, William Fraser Mackie Deans, Eustace Lionel Ernest Harrington, and Neil MacKinlay Sutherland (to United Kingdom Atomic Energy Authority). British Patent 965,334. July 29, 1964. Filed Apr. 4, 1962.

An apparatus is designed for the automatic measurement of the radioactivity of samples without preliminary determination of the level of the radioactivity. The apparatus comprises a sample chamber, a radiation measuring device for providing an electrical output with a magnitude proportional to the radioactivity, an electrical storage means, a timing means for causing after a predetermined delay the storage of the electrical value, comparison means for comparing the stored value with the succeeding output of the measuring device, and means for indicating the relationship between the stored value and the succeeding output. (D.L.C.)

35901 DUAL SENSOR GAMMA RAY CALORIMETER. James R. Coss, Maurice J. Cote, and Philip B. Hemmig (to U. S. Air Force). U. S. Patent 3,145,300. Aug. 18, 1964. Filed Mar. 7, 1961.

A gamma-ray dosimeter of the calorimeter type is designed for the measurement of dose rates above 10^7 ergs/g. The dosimeter comprises two cylindrical spaced bodies of dissimilar materials, e.g., carbon and lead, joined by a soft iron rod and located inside a thermal radiation buffer such as an aluminum shell. A thermocouple is located in each body, and the differential voltage produced between the thermocouples on exposure of the bodies to gamma radiation is taken to be a measure of the dose rate. (D.L.C.)

ISOTOPE TECHNOLOGY

General

35902 (TID-6613(Suppl.5)) RADIOISOTOPES IN WORLD INDUSTRY. ABSTRACTS OF SELECTED FOREIGN LITERATURE. (Division of Technical Information Extension, AEC). Aug. 1964. 134p.

Five hundred references are given to foreign reports and journals published from 1959 through 1963. Separate author, country, and Library of Congress card number indexes are included. (P.C.H.)

35903 (TID-20508) DEVELOPMENT OF ISOTOPE TECHNIQUES FOR RELOCATION OF LAND MONUMENTS. Final Report. Robert P. Petersen, C. Wesley Carnahan, Harry Faier, and Lee G. Radosevich (Entech Corp., Des Plaines, Ill.). Sept. 1963. Contract AT(11-1)-1278. 52p.

The marking of survey corners with either active or stable isotopes to allow easy relocation proves to be impractical for the conditions applicable to the U. S. Department of the Interior's land management activity. Relocation time, size of sources needed, health and safety aspects, and effects of burial under accumulated geological burden are discussed. (auth)

35904 PREPARATION AND POTENTIAL APPLICATIONS OF THE F-18 ISOTOPE. G. Nagy and Klara Berei (Central Research Inst. for Physics, Budapest). Magy. Tud. Akad. Kem. Tud. Oszt. Kozlemen., 21: 299-311(1964).

A review was made on the preparation and applications of ^{18}F. The isotope is prepared in a betatron, cyclotron, or nuclear reactor by irradiating targets such as fluorides, carbonates, nitrates, oxides, and gases. Various means for the isolation of the isotope from the irradiated target are available and it is also possible to prepare it in carrier-free form. ^{18}F is suitable as a tool in chemical reaction mechanisms and structure studies, as an aid in the activation-analytical oxygen determination, in biological investigations, and diagnostic purposes. The special significance of this isotope is its relatively short half time of 10 minutes. (OTS)

35905 CATALOGUE OF RADIOACTIVE PRODUCTS. RC. 9. Effective 1st April 1964. Amersham, Bucks, Eng., The Radiochemical Centre, [1964]. 164p.

This catalog lists some 2000 radioisotopes, labeled compounds, radioactive chemicals for medical use, radiation sources, and radioactive materials for instrument calibration. A list is included of publications and services available to users of radioactive products, and an index of available radioactive products is also included. (C.H.)

35906 FUEL CONTAMINATION IN A MARINE DIESEL ENGINE. A RADIOTRACER STUDY. B. E. Gordon (Shell Oil Co., Martinez, Calif.). 6p. (CONF-179-9)

From American Chemical Society Radionuclidic Exchange on Soils, Minerals, and Resins, Philadelphia, Apr. 1964.

A radiotracer method was applied to the problem of elucidating the mechanism of contamination of crankcase oil by fuel combustion products in a marine diesel engine. The method consisted of adding an oil soluble radioisotope to the fuel and tracing its route to the various lubricants used in the engine. It was found that of the total amount of combustion products and by-products that enter the crankcase oil, 65% enters by simple contamination via reintroduction of used cylinder lubricant and 35% by a condensation mechanism. (auth)

Industrial Applications

Refer also to abstract 35270.

35907 (NCSC-2477-2) APPLICATION OF NUCLEAR RADIATION AND RADIOISOTOPES TO TEXTILE MATERIALS AND PROCESSES. Progress and Quarterly Report, December 1, 1960–February 28, 1961. Arthur A. Armstrong, Jr., and Henry A. Rutherford (North Carolina State Coll., Raleigh. School of Textiles). Mar. 31, 1961. Contract AT(40-1)-2477. 62p.

Two conditions were found to increase the rate of acrylonitrile addition to cotton yarns by the vapor-phase technique: partial acetylation of the cotton and an increase in gas-flow rate. Post-irradiation grafting of acrylonitrile to cotton was investigated. The increase in weight was about 1% after the samples were extracted with dimethylformamide. The deposition of polymer was not uniform and the yarn had a harsh "hand." Irradiation of filament yarns of rayon, acetate, nylon, acrylic, polyester, and polypropylene in a nitrogen atmosphere did not change significantly the breaking strength, elongation, and modulus over the range of absorbed dose of 1.0×10^3 to 5.0×10^5 rads. Copper, manganese, and gold were added to cotton yarn as tags for activation analysis. Size and finish solutions were also tagged with gold and activation analysis then used to determine the size pick-up on cotton yarns and the finish pick-up on cotton cloth. The results were more satisfactory than when the usual chemical analytical procedures were used. Gamma spectra were presented for most of the commercial fibers after activation for 50 hours at a neutron flux of 10^{11} n/cm^2 sec. There were no distinguishing features of the spectra that permitted the absolute identification of a particular class of fibers. It is concluded that additives to man-made fibers will be necessary if neutron activation is used for identification. (auth)

35908 GAMMA RADIATION COMPARED WITH STEAM AND METHYL BROMIDE AS A SOIL STERILIZING AGENT. Charles F. Eno and Hugh Popenoe. Soil Sci. Soc. Am. Proc., 28: 533-5(July-Aug. 1964).

Red Bay loamy fine sand and Everglades muck were sterilized with gamma radiation, steam, and methyl bromide. Exchangeable NH_4^+; extractable N, P, and S; moisture equivalent; cation-exchange capacity; and organic matter were measured. None of the sterilization treatments significantly altered cation-exchange capacity. Steam significantly increased the amounts of N, P, and S extracted and the organic matter content values, compared to the check and the other two soil treatments; it also significantly decreased the moisture equivalent percentage. Gamma and methyl bromide sterilization generally increased the release of N, P, and S above the check. There was also a strong indication, based on the N data, that sterilization by gamma rays disrupted the soil organic materials more than methyl bromide. Finally, the intensity of all these factors is most closely associated with the organic matter content of the soil. Therefore, a sand, for example, would not be altered nearly as much as a loam or an organic soil. (auth)

35909 DESIGN OF IRRADIATION FACILITIES IN FOOD PROCESSING TECHNOLOGY. W. Koepcke (Technische Universität, Berlin). p.178-89 of "Atomstrahlung

in Medizin und Technik." Munich, Verlag Karl Thiemig KG, 1964. (In German)

A review of radiation sources used in irradiation facilities served as an introduction to a discussion of facilities for the sterilization of food and pharmaceuticals in the United States and England. The principal problems in each of the designs discussed are briefly indicated. (J.S.R.)

35910 CONTINUOUS MONITORING AND CONTROL OF MOISTURE CONTENT OF SINTERED ORES BY A NEUTRON SCATTERING PROCEDURE. F. Hombeck, W. Kuehn, and H. Neuhaus (Klockner-Werke Ag, Hutte Haspe, Ger. and Institut Karlsruhe der Isotopen-Studiengesellschaft, Ger.). p.317-330 of "Atomstrahlung in Medizin und Technik." Munich, Verlag Karl Thiemig KG, 1964. (In German)

The applicability of the elastic scattering of fast neutrons to the measurement of the moisture content of crude ores was critically investigated. The principles of such a method are discussed, and the experimental set-up is described. It was determined that the geometry of the measurement cell, the bulk density of the material to be measured, and the chemical composition of the ore affect the measurement results significantly. Possible continuous measurement arrangements for the moisture determination of specific ores are described. (J.S.R.)

35911 RADIOISOTOPES IN AGRICULTURE. Hellmut Glubrecht and Ernst-Georg Niemann (Technische Hochschule, Hanover). p.337-50 of "Atomstrahlung in Medizin und Technik." Munich, Verlag Karl Thiemig Kg, 1964. (In German)

A bibliographic survey is given of the uses of radioisotopes in agriculture. The uses discussed are analysis, radiation effects, position labeling, isotope labeling, and indicator activation methods. 118 references. (J.S.R.)

35912 USE OF RADIOISOTOPES AND IONIZING RADIATION IN AGRICULTURAL SCIENCE. A. Suess (Bayerische Landesanstalt fur Bodenkultur, Pflanzenbau und Pflanzenschutz, Munich). p.351-7 of "Atomstrahlung in Medizin und Technik." Munich, Verlag Karl Thiemig KG, 1964. (In German)

The studies made at the Bayer Landesanstalt für Bodenkultur, Pflanzenbau, and Planzenschutz on the use of radioisotopes and radiation in agricultural science are reviewed. Among the studies discussed are the spread of insect pests, early detection of virus infection, tracing growth patterns, germination, production of mutations, and uptake of nutrients. Examples of the results obtained are given to indicate the type of information that can be obtained with the use of radioisotopes and radiation. (J.S.R.)

35913 ECONOMIC IMPORTANCE OF ISOTOPE AND RADIATION USE. Georg Proepstl (Euratom-Eurisotop, Brussels). p.358-64 of "Atomstrahlung in Medizin und Technik." Munich, Verlag Karl Thiemig KG, 1964. (In German)

It is difficult to assess accurately the economic importance of isotope and radiation use as often as no energy or material output results. They are introduced as auxiliaries in an existing fabrication or manufacturing scheme. In addition to the production of isotopes and other radiation sources, detection and monitoring instruments must be fabricated. The production of isotopes, development of radiation instruments and methods, and yearly economies in the use of isotopes are the specific topics discussed to show the economic impact of the use of isotopes and radiations industrially and medically. (J.S.R.)

35914 NUCLEAR PROCESS CONTROL EXPERIENCE IN THE PAPER INDUSTRY. George I. Doering. 8p. (CONF-624-1)

From Symposium on Nuclear Applications to the Wood, Paper, and Pulp Industries, Pullman, Wash., Apr. 1964.

The use of radioisotopes in the kraft pulping process and control of basic weight on the fourdrinier paper machine are discussed. Other significant applications mentioned briefly are on and off machine paper coatings, polyethylene extrusion coating, and miscellaneous paper converting operations, such as gummers, impregnation processes, and sand paper manufacture. Factors that must be considered in developing a source detector geometry that will give suitable measurement results to the paper maker are listed and discussed. (P.C.H.)

Separation and Production

35915 (ORNL-tr-265) ULTRACENTRIFUGE FOR THE SEPARATION OF GAS MIXTURES, FOR EXAMPLE, MIXTURES OF GASEOUS ISOTOPES. Johannes Los and Fridjof Ernst Trangott Kelling. Translated by A. Houtzeel (Oak Ridge National Lab., Tenn.), from Dutch Patent 103,433. Mar. 17, 1960. 6p.

An ultracentrifuge is designed in which the usual disadvantages encountered with the friction disk are avoided. In the ultracentrifuge, the rotary tube takes the shape of a tube open at one end while the separation space at that side is limited by the friction disk. The stability of the rotor is improved, and the separation space is not shortened by the friction disk. (D.L.C.)

35916 THE PREPARATION OF A ^{57}Co SOURCE ON A CHROMIUM BACKING FOR STUDY OF THE MÖSSBAUER EFFECT. S. B. Tomilov. Radiokhimiya, 6: 377(1964). (In Russian)

The isotope ^{57}Co is obtained by irradiating an iron target on a cyclotron. Most of the iron is removed by solvent extraction into diethyl ether from 6 N HCl. The aqueous HCl solution is evaporated to dryness, and the residue is dissolved in a minimum amount of 12 N HCl, which is passed through an anion exchange column in the chloride form. Ni, Mn, and other impurities pass through the column. Co and Cu are eluted from the anion column with 4 N HCl. The Co and Cu are again adsorbed on an anion column from 12 N HCl, and the Co is separated from Cu by careful elution with 4 N HCl. The ^{57}Co is eluted in the first free column volume, and evaporated to dryness on a chromium disk. After drying, the cobalt chloride is reduced to metal by heating 15 to 30 minutes at 500°C in a current of hydrogen, and fixed to the backing by heating 5 to 15 minutes at 1300 to 1400°C. The specific activity of this ^{57}Co source is sufficiently high so that the weak γ rays are not adsorbed in the source, which can be used in studies involving the Mössbauer effect. (TTT)

35917 PRODUCTION AND PROCESSING OF RADIOISOTOPES. R. Schubert (Kernreaktor Bau- und Betriebs-GmbH, Karlsruhe, Ger.). p.217-21 of "Atomstrahlung in Medizin und Technik." Munich, Verlag Karl Thiemig KG, 1964. (In German)

The facilities of the FR-2 Reactor for the production of radioisotopes and the design of a newly constructed isotope laboratory for the processing of the isotopes produced are described. (J.S.R.)

35918 EXPERIMENTS ON THE PRODUCTION OF RADIOISOTOPES IN SWIMMING-POOL REACTORS. W. Marth. p.222-38 of "Atomstrahlung in Medizin und Technik." Munich, Verlag Karl Thiemig KG, 1964. (In German)

At the Munich Research Reactor, irradiations were carried out for studies in nuclear physics, solid-state physics, and radiochemistry for the production of short-lived ra-

dioisotopes. Methods were developed for each of these purposes, and they are briefly reviewed. The calculations of the irradiation costs in the reactor are shown. (J.S.R.)

35919 CONCENTRATION AND USE OF STABLE ISOTOPES. W. Groth (Universität, Bonn). p.239-51 of "Atomstrahlung in Medizin und Technik." Munich, Verlag Karl Thiemig KG, 1964. (In German)

Methods for the concentration of deuterium and ^{235}U are summarized and contrasted. The principles of the dual-temperature method for deuterium enrichment is emphasized. The methods described for ^{235}U enrichment are gaseous diffusion and gas centrifugation. The methods used for the enrichment of isotopes of C, N, and O are indicated. (J.S.R.)

MATHEMATICS AND COMPUTERS

Refer also to abstracts 35276, 35277, and 36728.

35920 (AERE-Bib-145) ASSOCIATIVE OR CONTENT-ADDRESSED STORES. R. C. M. Barnes and I. N. Hooton (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). July 1964. 16p.

The main sections of the bibliography give references to content-addressed storage systems using cryogenic, magnetic, and electronic techniques, covering the period 1956 to 1963. Subsidiary sections give selected references to the devices and techniques used in these stores, some related programmed methods of file organization, and the specialized problems of multiple responses and ordered retrieval. (auth)

35921 (HW-SA-3190) CONTROL OPTIMIZATION BY VARIATIONAL CALCULUS. Albert L. Ruiz (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Sept. 10, 1963. Contract AT(45-1)-1350. 24p.

The use of dynamic programming to synthesize an optimal control system when the performance index is expressed as an integral leads to results that have been shown to be equivalent to the use of the calculus of variations with natural boundary conditions. With this approach, the extension to other types of boundary conditions is not obvious. On the other hand, the use of the calculus of variations leads to results for all types of boundary conditions, as long as the variables are continuous. For a linear process and quadratic performance index, the derived control law is the same for all cases of admissible boundary conditions, and the feedback factors and gains are calculated from sets of first order differential equations that are of the same general form in each case, although differing in detail. For a nonlinear process or a nonquadratic performance index, the method gives a symbolic expression for the optimal control law. The evaluation of this expression for particular problems depends on one's ability to solve, exactly or approximately, a nonlinear differential equation. (auth)

35922 (SC-RR-64-546) THREE-DIMENSIONAL SURFACE FIT, M-151. David G. Kitzinger (Sandia Lab., Albuquerque, N. Mex.). July 1964. Contract AT(29-1)-789. 20p.

The M-151 computer method permits a three dimensional array to be represented by a mathematical equation. This method uses nth order multiple interpolation with extensive transformation of variables to describe most three dimensional functions. An error analysis aids the programmer in choosing the best fit of a function from successive approximations of that function. (auth)

METALS, CERAMICS, AND OTHER MATERIALS

General

Refer also to abstract 36751.

35923 (AD-602215) MACROLAMINATE PARTICLE DEVELOPMENT. Interim Report No. 1, April 1–June 1, 1964. F. H. Simpson (Boeing Co. Aero-Space Div., Seattle). Contract NOw-64-0194-f. 21p.

A program for evaluating processing parameters including macrolaminate particle geometry, forming methods, and sintering is described. A $93.1HfO_2-4.9CeO_2 \cdot 2MgO$–Mo system is evaluated as a macrolaminate particle composite material. (auth)

35924 (BMI-1678) DEVELOPMENT OF HIGH-DIELECTRIC-CONSTANT, LOW-DIELECTRIC-LOSS POLYMERS UTILIZING GAMMA IRRADIATION. Manfred Luttinger, Francis A. Sliemers, Jr., John F. Kircher, and Robert I. Leininger (Battelle Memorial Inst., Columbus, Ohio). July 22, 1964. Contract W-7405-eng-92. 33p.

The polymerization of methyl methacrylate, β-cyanoethyl acrylate, ethyl vinyl sulfone, and β-trifluoroethyl vinyl ether and the copolymerization of β-cyanoethyl acrylate and ethyl vinyl sulfone were investigated for optimum polymer production and purity by radiation and chemical catalytic methods. Dielectric constants and dissipation factors were determined, but no significant difference between the dielectric properties of free-radical polymerized polymers prepared by γ radiation or by chemical catalysts was discovered. The polymerization of ethyl vinyl sulfone proceeded only with great difficulty, and only moderate yields of low-molecular-weight polymers were obtained. The copolymerization of ethyl vinyl sulfone and β-cyanoethyl acrylate did not improve the yields materially, but resulted in a small increase in molecular weights. The dependence of the dielectric constant on the glass transition temperature in the homopolymers and copolymers of these two monomers was defined. β-Trifluorethyl vinyl ether was polymerized by γ radiation below room temperature at a dose rate of 5×10^5 rep per hr and a total dose of 1.6×10^7 rep. The attempted radiation polymerization of some allylic monomers, both in the solid and in the liquid state, was unsuccessful. (auth)

35925 (BMI-1680) THORIUM AND THORIUM–URANIUM COMPOUNDS AS POTENTIAL THERMAL BREEDER FUELS. Neal M. Griesenauer, Martin S. Farkas, and Frank A. Rough (Battelle Memorial Inst., Columbus, Ohio). July 28, 1964. Contract W-7405-eng-92. 33p.

The compounds Th_2Al, ThB_4, $ThBe_{13}$, ThC, ThC_2, Th_3Si_2, and ThSi with and without additions to their uranium counterparts, were prepared by arc casting. Microstructural studies showed that with the exception of the aluminide, the uranium substituted for the thorium in solid solution in the compounds. Oxidation tests in dry air and CO_2 up to 540°C indicated greatest oxidation resistance by the borides and beryllides; however, above 540°C the beryllides exhibited rapid oxidation in dry air. In corrosion tests of the compounds in NaK at 650°C, Santowax R at 350°C, and water at 90°C the borides and beryllides were not attacked. Thermal conductivity and expansion were determined on the monocarbide, dicarbide, tetraboride, and beryllide containing 10 mole per cent of their uranium counterparts. Compression tests and hardness measurements showed that (90Th–10U)C and (90Th–10U)B_4 have nil-ductility strengths greater than 67,000 psi at 980°C. Compatibility tests utilizing the monocarbide, dicarbide, tetraboride, and beryllide containing both 10 and 20 mole per cent of their uranium counterpart versus potential cladding materials revealed that the beryllides were the most reactive of the compounds tested. (auth)

35926 (BM-RI-6506) ELECTROREFINING OF COLUMBIUM. R. E. Cumings and F. R. Cattoir (Bureau of Mines, Boulder City, Nev.). 1964. 14p.

Niobium metal was electrorefined in a fused-salt electrolyte. Excellent results were obtained in lowering the impurity content in a 94% Nb anode feed material to produce a 99.8%-pure metal. The reductions of the major impurities follow: oxygen from 19,800 to 500 ppm, carbon from 9,700 to 25 ppm, iron from 9,200 to 630 ppm, nitrogen from 2,100 to 90 ppm, and silicon from 750 ppm to not detected. Nb with a purity of 99.9% was produced from 99.5- and 99.8% grades of Nb. The investigation was devoted to the evaluation of a fused-fluoride-salt electrolyte ($KF-NaF-K_2NbF_7$) for electrorefining Nb. The effects of the Nb concentration and the voltage upon the product's purity were investigated. The effect on the cathode current efficiency of ampere-hours of deposition and the formation of a dual valence state of the Nb was also investigated. (auth)

35927 (BNL-866) HIGH-TEMPERATURE LIQUID-METAL TECHNOLOGY REVIEW. A Bimonthly Technical Progress Review. Volume 2, Number 2. (Brookhaven National Lab., Upton, N. Y.). Apr. 1964. Contract [AT (30-2)-Gen-16]. 56p.

Reviews are presented of 32 papers on fluid dynamics, heat transfer, materials development and corrosion, instrumentation, component development, system studies, chemical analysis and chemistry, fabrication techniques, and physical properties and thermodynamics. (N.W.R.)

35928 (BNL-875) HIGH-TEMPERATURE LIQUID-METAL TECHNOLOGY REVIEW. A Bimonthly Technical Progress Review, Vol. 2, No. 3. (Brookhaven National Lab., Upton, N. Y.). June 1964. Contract AT-30-2-GEN-16. 33p.

Reviews are presented of 18 papers on physical properties and thermodynamics, fluid dynamics, heat transfer, material development and corrosion, instrumentation, component development, system studies, chemical analysis and chemistry, and fabrication techniques. (N.W.R.)

35929 (GA-4769(Pt.I)) INVESTIGATIONS OF CARBIDES AS CATHODES FOR THERMIONIC SPACE REACTORS. Final Report. L. Yang, D. L. Bosseau, F. D. Carpenter, et al. (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Mar. 17, 1964. Contract NAS 3-2532. 371p.

The fabrication, evaluation, radiation testing, mechanical analysis, and cladding-evaluation of UC and UC–ZrC emitters for nuclear-thermionic power plants are reviewed. Other carbide mixtures (e.g., UC–NbC, UC–TaC, UC–MoC), cermets (W–UO_2 and W–UC), and UO_2 are also analyzed as regards their thermionic emission capabilities. Various refractory alloys and metals are studied as claddings. (T.F.H.)

35930 (HW-68600-40) PLUTONIUM ABSTRACTS. Volume 4, Number 6. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). July 1, 1964. Contract AT(45-1)-1350. 22p.

Twenty-eight references on Pu in biology and medicine, chemistry, health and safety, metallurgy and ceramics, physics, and reactor technology are given to reports and journals published from March through June, 1964. (P.C.H.)

35931 (HW-81600) CERAMICS RESEARCH AND DEVELOPMENT OPERATION. Quarterly Report, January–March 1964. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Progress is reported in the following sections: ceramics research, fuel development, and fuel testing and analysis. Separate abstracts are prepared for each section. (N.W.R.)

For abstracts of individual sections see: 35932, 36791, and 36792.

35932 (HW-81600(p.2.1-23)) CERAMICS RESEARCH. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Irradiated specimens of PuO_2 and PuN were examined after exposures of about 20×10^{20} fissions/cm^3. Nichrome and PuO_2 were found to be compatible at 900°C, and beta-Pu_2O_3 was found to react with thorium metal at about 500°C. Tests have shown that vacuum outgassing at 250°C is sufficient to remove oil contamination from a deep bed of pneumatically impacted UO_2-PuO_2 powders. UO_2 pellets were melted by direct induction coupling to a preheated sample. Metallographic examination of a UO_2 single crystal, irradiated to $\sim 5 \times 10^{20}$ fissions/cm^3 at temperatures less than 400°C, shows a 15μ wide zone of porosity at the exposed specimen surfaces. Solid solutions of PuN–UN and PuN–ZrN were compounded and are being evaluated to determine if thermal decomposition rates are less than those for pure PuN. The microhardness of a (100) crystal face of UN shows four-fold rotational symmetry. Three capsules, containing UN–20 wt % PuN, were fabricated and charged into the Materials Test Reactor. The effect of small quantities of UO_2(< 10 vol %) and UO_2 particle alignment on the fracture strength of tungsten–UO_2 cermets was investigated. The absorption spectra for single crystal ThO_2 was measured between 0.3 and 2.5 μ; an absorption edge was measured at 3.9 ev. The density of dry pressed ThO_2 pellets, fired to 1150°C for 90 minutes, ranged from 86.1 to 93.0% TD depending upon the forming pressure. The melting points and microhardness of Nd_2O_3 and Sm_2O_3 were determined. A high temperature vacuum push-rod dilatometer was developed. The high temperature Brew furnance was adapted for making continuous weight loss measurements and vibrational tests at high temperature in various atmospheres. (auth)

35933 (ML-TDR-64-56) SUBSTRUCTURE AND MECHANICAL PROPERTIES OF REFRACTORY METAL WIRES. Roy Kaplow, John F. Peck, Frank T. J. Smith, and David A. Thomas (Massachusetts Inst. of Tech., Cambridge). Feb. 1964. Contract AF33(657)-11238. 52p.

Polycrystalline niobium wires show steady work hardening in wire drawing to the highest strain obtained, a true strain of 5.1. This behavior contrasts to fcc metals, which show saturation of work hardening at true strains greater than 2. During drawing of random-texture niobium, a fibrous microstructure and the [110] wire texture continually develop. If the material has an initial [110] texture, however, the texture diminishes because of deformation band formation, and subsequent recrystallization produces near-random orientation. Swaged wire also shows continued work hardening and develops a cylindrical texture at high strains. Torsion stress-strain curves for both polycrystalline and single crystal niobium were obtained and the effect of strain reversal studied. A region of work softening was observed in both as-drawn wire and single crystals after reversal of comparable forward strains in drawn wire annealed at 700°C or above prior to testing. The substructures produced during these experiments were studied by electron microscopy and an attempt made to correlate the structure after forward straining with the extent of work softening. The results are discussed in terms of a jog-vacancy mechanism of work hardening. (auth)

35934 (ML-TDR-64-125(Vol.I)) IMPROVED GRAPHITE MATERIALS FOR HIGH-TEMPERATURE AEROSPACE USE. VOLUME I. RESEARCH AND DEVELOPMENT FOR IMPROVED GRAPHITE MATERIALS. (Union Carbide Corp. Carbon Products Div. Advanced Materials Lab., Lawrenceburg, Tenn. and Union Carbide Corp. Carbon Products Div. Research Lab., Parma, Ohio). Mar. 1964. Contract AF33(657)-11171. 159p.

Progress is reported on the basic studies of mechanisms of carbonization of model aromatic compounds. The survey of the thermal reactivity of model compounds was continued with the examination by differential thermal analysis of 63 additional substituted aromatics and heterocyclics. The pyrolysis behavior of two different pitches was examined in a thermogravimetric apparatus. Electron spin resonance (ESR) spectra were obtained under conditions of high resolution for solutions of acenaphthylene in m-quinquephenyl. Nuclear magnetic resonance (NMR) measurements are reported for some aromatic ions, aromatic pyrolysis products, and complex raw materials for graphite. The thermal decomposition of organic diazo-compounds was investigated as an example of a pyrolysis reaction involving radical intermediates but yielding stable diamagnetic products. X-ray data were obtained for the [002] semilattice spacing in graphite prepared from pure aromatic hydrocarbons and from complex raw materials. Molecular structure is seen to influence graphite properties, through both steric and reactivity effects. Generalized reaction sequences were prepared for the formation of graphite from the model compounds acenaphthylene and 9,9′-bifluorenyl. The carbonization of two aromatic hydrocarbons, fluoranthene and p-terphenyl, both of which yield disordered graphite, was investigated. The addition of carbon blacks to coking charge stocks prior to the coking operation results in cokes that have isotropic high thermal expansion characteristics. Laboratory air-blown asphalts were found to be source stocks for producing isotropic high thermal expansion graphites. Experiments in the pilot coker on thermal expansion reduction of a virgin residuum-based coke produced low thermal expansion coke of good uniformity. High and low thermal expansion cokes from vacuum residuum and slurry oil charge stocks were processed into graphite. Testing showed that the original coke properties affect the final graphite properties. (auth)

35935 (MLM-CF-64-8-1) EPOXY FOAMS RESISTANT TO HIGH TEMPERATURES. L. E. Brown and J. B. Harshman, Jr. (Mound Lab., Miamisburg, Ohio). July 31, 1964. Contract AT(33-1)-Gen-53. 14p.

A new, heat-resistant epoxy foam was recently reported by Chen and Nixon. It consists of Epon 828, 4,4′-diamino diphenyl sulfone (DDS) and trimethoxyboroxine (TMB). Because of its potential applications, this foam and several modifications were evaluated. The modifications

included other curing agents and a two-component resin system. The basic formulation was superior to its modifications in heat and solvent resistance. It also had a lower density and, consequently, a lower compressive strength. In flammability tests, all samples were self-extinguishing. For comparison of the basic formula with two-component systems, Epon 828 was cured separately with DDS and with TMB. These two-component systems did not foam. In qualitative determinations, the 828-DDS softened at 350-360°C; the basic formulation softened at 340°C; and the 828-TMB softened at 320°C. Chen and Nixon hypothesized that DDS and TMB react initially to form a highly cross-linked polymer, which then rapidly cures the epoxy resin. Attempts to prepare this polymer were unsuccessful. Other observations also tend to show that the hypothetical mechanism is improbable. A new mechanism is proposed in which all three components react initially to form one polymer with the evolution of methanol. This mechanism appears to fit the observed results better than that proposed by Chen and Nixon. (auth)

35936 (NAA-SR-9508) URANIUM CARBIDE TRANSIENT HEATING EXPERIMENTS. PHASE I. S. J. Stachura, M. Silberberg, and R. N. Cordy (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Aug. 1, 1964. Contract AT-11-1-GEN-8. 96p.

Two in-pile capsules containing mock-up uranium carbide fuel rods were subjected to a total of five neutron bursts in the TREAT facility with initial reactor periods ranging from 0.26 to 0.10 sec. The first capsule received two preliminary bursts (30.7 and 63.3 Mw-sec) and a final burst (181 Mw-sec) which brought the fuel temperature to about 2800°F, a value well in excess of the melting point of the free uranium of the hypostoichiometric uranium carbide (4.58 wt % carbon). No appreciable structural changes were observed as a result of this transient. The second capsule, following one preliminary burst (31.4 Mw-sec), was subjected to a 293 Mw-sec TREAT transient which raised the fuel temperature above 4000°F. This generated 144 Btu/in.^{3} in the uranium carbide during a pulse of 0.4 sec half-width. In spite of the high temperature levels and thermal stress, no gross deformation of fuel or cladding occurred. Bond boiling (<50 msec duration) was apparent during the final transient. There is also a possibility that the conditions of the transient caused solution of a portion of the free uranium into the grains of the hypostoichiometric uranium carbide. The thermal and mechanical behavior of the Phase I experiments were in agreement with the predicted behavior of the system, thus indicating that no anomalous behavior occurs during rapid heating to the region of the uranium carbide melting point. (auth)

35937 (NAA-SR-9796) PERFORMANCE OF STRUCTURAL MATERIALS EXPOSED TO THE COOLANT IN THE OMRE. R. S. Neymark (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Aug. 1, 1964. Contract AT(11-1)-Gen-8. 32p.

Two dummy elements, DE-1 and DE-2, were placed in the core of the Organic Moderated Reactor Experiment (OMRE) at its initial startup, each containing tensile, corrosion, U-bend, and impact specimens. An additional specimen holder was placed in a line used to by-pass OMRE coolant around the core. The first dummy element, DE-1, was removed from the core after eight months exposure and the second, DE-2, was removed eighteen months later. Thus, specimens were exposed in the core for eight and for twenty-six months, and in the by-pass line for thirteen months. A summary is presented of the results and performance of the specimens exposed in DE-2, and of the results from all three groups of specimens. The U-bend specimens from all three groups displayed no evidence of accelerated corrosion in high stress areas, nor were any cracks discovered. Stressed coupons exposed in the OMRE appeared immune to the problems usually associated with stressed components exposed to an electrolyte. The impact specimens displayed a loss of ductility as might be expected from irradiation to about 5×10^{19} nvt (fast, E > 1 Mev). The greatest loss of energy absorption was displayed by the carbon steel, with SAE 4130 alloy steel, Type 410 stainless, and Type 304 stainless steels less affected, in decreasing order. Corrosion of carbon steel was at a fraction of a mil per year; corrosion decreased with rising alloy content of the steels. Aluminum was very resistant, but unprotected magnesium corroded extensively when exposed to the organic coolant. Tensile property changes were typical for the materials involved at the accumulated irradiation dosages. Again, the ferrous alloys were affected in reverse order of their alloy content, from unalloyed to stainless steels. The tensile strength of aluminum was unaffected, although its yield strength increased. Tensile specimens of magnesium showed significant loss of strength, probably due to corrosion and pitting. Results from tensile, corrosion, and impact specimens exposed in the three groups were compared. It was concluded that service in an organic reactor core is unusually mild in terms of corrosion, and that the radiation damage should be comparable to exposures in any other type of reactor. (auth)

35938 (NMI-2129) FUNDAMENTAL AND APPLIED RESEARCH AND DEVELOPMENT IN METALLURGY. Progress Report to United States Atomic Energy Commission for the Month of May 1964. (Nuclear Metals. Div. of Textron Inc., West Concord, Mass.). July 17, 1964. Contract AT(30-1)-2784. 70p.

The fabrication of tungsten and rhenium-tungsten tubes by drawing and extrusion is described. Metallographic and ring compression data are obtained on the extruded tubing and on its response to anneals. The purity of zone-refined beryllium crystals is evaluated by resistance ratio measurements. Substantial quantities of splatcooled U–Al–Si and Zircaloy-2-Be SLIS systems were produced. Fabrication of splatcooled U–Al–Si, U–Be, U–C, and Zircaloy-2–Be SLIS systems into rod stock by extrusion was completed. Tensile testing of the U–Be, U–C, Zr–Be, and Zircaloy-2–Be systems to 600°C was conducted. In addition electron microscopic studies of the U–Be–C and Zr–Be systems were completed. (N.W.R.)

35939 (NP-14192) INVESTIGATION OF BORIDE COMPOUNDS FOR VERY HIGH TEMPERATURE APPLICATIONS. Semi-Annual Report No. 3. Larry Kaufman (ManLabs, Inc., Cambridge, Mass.). May 1964. Contract AF33(657)-8635. 129p.

High density specimens of ZrB_2 and HfB_2 covering a range of B/Me ratios were prepared by high pressure-hot pressing and characterized by x-ray, metallographic, pycnometric, and chemical analysis. Oxidation measurements on metal-rich ZrB_2, metal-rich HfB_2, boron rich HfB_2, hafnium doped-boron rich HfB_2, and tantalum doped-boron rich HfB_2 were performed at temperatures up to 1850°K and at oxygen pressures of 0.4 and 40 torr. These measurements support the predictions i.e. at 1850°K metal rich HfB_2 (B/Me = 1.88 or 65.3%B) has a parabolic rate constant for oxygen pickup which is one eighth that of boron

rich HfB_2 (B/Me = 2.12 or 67.9%B). Metal rich ZrB_2 has a rate constant one third that of stoichiometric ZrB_2. Moreover, additions of Hf to boron rich HfB_2 without complete homogenization does not produce the enhancement of oxidation resistance expected on the basis of B/Me chemistry. Sintering studies on ZrB_2 suggest that densities approaching theoretical limits can be achieved at about 2100°C in the presence of impurities. Measurements of the thermal conductivity and emissivity of TiB_2, ZrB_2, HfB_2, and NbB_2 were performed on high density specimens between 1000 and 1700°C. In addition, electrical resistivity data for ZrB_2 and HfB_2 are reported to 1500°C. Estimates were made of the free energies of formation of the monoborides of hafnium and zirconium in order to compute Hf-B and Zr-B phase diagrams. The computed diagrams are presented and compared with experimental studies of the metal rich diboride phase boundaries in order to clarify and improve the current description of high temperature equilibria in these systems. Theoretical methods for predicting the relative oxidation resistance of the pure diborides and the off-stoichiometric compositions based on minimizing the B_2O_3 pressure or the boron activity gradient across the oxide layer are presented. These idealized descriptions, together with considerations of oxide stability, oxide-boride volume coherency, and a thermodynamic treatment of ternary diborides were performed in order to guide the alloying program. An interesting result of the latter analysis is that elements which substitute on the boron sublattice will depress the boron activity more effectively than those which enter on the metal lattice. (auth)

35940 (ORNL-3662) PREPARATION AND EVALUATION OF VAPOR-DEPOSITED TUNGSTEN. R. L. Heestand, J. I. Federer, and C. F. Leitten, Jr. (Oak Ridge National Lab., Tenn.). Aug. 1964. Contract W-7405-eng-26. 34p.

Vapor deposition of tungsten has been investigated as a possible process for fabricating both intricate shapes and intermediate products for subsequent working. In contrast to the extensive equipment required in the commercial production of tungsten, inexpensive equipment of a simple nature was used in this investigation. Vapor deposition of tungsten by the hydrogen reduction of tungsten hexafluoride was studied over the temperature range 500 to 1000°C, H_2/WF_6 ratios of 70:1 and 140:1, and pressures of 10 and 20 torr. The effect of these parameters on deposition rates and characteristics of the deposits were determined. Within the temperature range studied the deposition profiles showed that uniformity of thickness of tubular deposits was favored by low temperatures. A high efficiency of WF_6 utilization was obtained for tubular deposits. Comparison of the weight of WF_6 with the weight of tungsten deposit showed 95% efficiency of reduction. Factors affecting purity of the deposits, with emphasis on minimizing interstitial impurities, are discussed. A purity that equals or exceeds the purity of commercial tungsten was readily obtained. The deposits were generally highly oriented and possessed a columnar grain structure having the major axis of the grains perpendicular to the substrate. Deposits were also characterized by x-ray diffraction and by electron microscopy. The results of this study indicate that vapor deposition is an efficient and expedient method of fabrication for many applications, giving products comparable to those fabricated by conventional techniques. (auth)

35941 (ORNL-RMIC-2) RMIC BULLETIN. (Oak Ridge National Lab., Tenn.). June 1964. Contract [W-7405-eng-26]. 62p.

The Research Materials Information Center, which is part of the Pure Materials Program of the Solid State Division at ORNL, has the function of collecting and providing information on the purification, production, characterization, and availability of inorganic research quality materials. Three papers are presented on the preparation of pure Cu and Fe crystals and on available and desired materials. Separate abstracts were prepared for all three papers. (D.L.C.)

For abstracts of individual papers see: 35504, 35942, and 35943.

35942 (ORNL-RMIC-2(p.3-9)) GROWTH OF COPPER CRYSTALS OF LOW DISLOCATION DENSITY. F. W. Young, Jr., and J. R. Savage (Oak Ridge National Lab., Tenn.).

Crystals (up to 1 × 6 in.) were grown from 99.999+% Cu by a Bridgman method and were examined for dislocation density by acid sawing and polishing slices with (111), (100), and (110) faces and using etch-pit techniques. The orientation of the growth axis of unseeded crystals was essentially random. A correlation between growth direction and crystal perfection was found, the dislocation density being an inverse function of the angular deviation of the growth direction from the (111) zone. Subsequent annealing of the slices at 1075°C for one week reduced the dislocation density, and a number of samples with a dislocation density $<5 \times 10^2/cm^2$ have been prepared. (auth)

35943 (ORNL-RMIC-2(p.10-16)) THE PREPARATION OF HIGH PURITY SINGLE CRYSTALS FROM ELECTRON BEAM ZONE REFINED IRON. E. J. Hughes and P. W. Barton (Materials Research Corp., Orangeburg, N. Y.).

The factors affecting the efficiency of the float-zone refining technique are discussed, and the application of electron-beam zone refining to the purification of iron is described. Using this technique, polycrystalline iron containing an average of <1 ppm, 7 ppm, and 8 ppm of nitrogen, carbon, and oxygen respectively has been consistently produced. The theory of the strain anneal technique for single crystal growth is discussed, and a method for growing single crystals from zone-refined polycrystalline material is described. The purity of the crystals was assessed by chemical analysis, mechanical property measurements at −196°C, and the measurement of the ratio of the resistivity at room temperature to that at 4.2°K. The chemical analyses gave average values of <1 ppm, 8 ppm, and 19 ppm for the nitrogen, carbon, and oxygen respectively. Tensile tests carried out at −196°C showed that at this temperature crystals of all orientations were ductile, the greatest strain to fracture being observed for orientations near the (100) pole. Resistivity ratios were in the range 200 to 300. (auth)

35944 (WAL-TR-401/303-4) DEVELOPMENT OF TOUGH, HIGH-STRENGTH ALPHA-BETA TITANIUM-BASE ALLOYS AT 240,000-260,000 PSI YIELD STRENGTH LEVEL. Quarterly Progress Report No. 5, June 26-September 25, 1963. P. A. Farrar and H. Margolin (New York Univ., New York. School of Engineering and Science). Contract DA-30-069-ORD-3690. 21p. (AD-431680)

Titanium alloys were melted and forged to ½-in. bar stock. These alloys were tested and melted for further evaluation as bar, plate, and sheet. The compositions chosen for further evaluation were those which would give the desired ductility for the strength levels at 190,000 to 240,000 psi 0.1% yield strength. (auth)

35945 THE USE OF PLASTICS IN NUCLEAR ENERGY TECHNOLOGY. H. Wilski. Kunststoffe, 53: 862-4(1963). (In German)

It was found that considerable variations can be produced on stressed wires of polyethylene under short-time and extended irradiation. These variations do not occur in polyethylene terephthalate and only slightly in polyvinyl chloride. Uses for polyethylene in nuclear technology are described. (tr-auth)

35946 ELECTROLYTIC DECONTAMINATION OF THE SURFACE OF STEEL CONTAMINATED BY RADIOACTIVE ISOTOPES. Maria Miazek-Kula. Prace Central. Inst. Ochrony Pracy, 12: No. 36, 134-50(1962). (In Polish)

An electrolytic method for decontaminating the surface of superstainless steel contaminated by $^{90}Sr(^{90}Y)$, ^{60}Co, ^{35}S, or ^{32}P is reported. Tap water and 0.2N H_2SO_4 were principally used as electrolytes. Among other factors, the investigations also embraced the influence of density, type, and direction of the electric current upon the degree of decontamination. (auth)

35947 A STUDY OF THE CONDITIONS FOR THE PREPARATION OF NIOBIUM CARBIDE. V. N. Paderno and Yu. K. Lapshov. Soviet Powder Met. Metal Ceram. (English Transl.), No. 1, 57-60(Jan.-Feb. 1963).

The preparation of niobium carbide by the reduction of niobium pentoxide by carbon black in an atmosphere of hydrogen and in vacuum was investigated. Experimental results show that the optimum charge is one where the carbon black is 97% of the calculated amount and that the charge should be double heated at a temperature of 1700°C for one hour. (Rev. Metal Lit., (June 1964))

35948 ON THE VACUUM REDUCTION PROCESS FOR THE PRODUCTION OF NIOBIUM METAL. Hirozo Kimura and Yasuo Sasaki. Trans. Natl. Res. Inst. Metals (Tokyo), 5: 213-18(1963).

Using the vacuum process, carbide reduction of niobium pentoxide was investigated to provide a clearer picture of the reduction of niobium oxide with niobium carbide. Ductile Nb metal was obtained through vacuum reduction and refining. Fluctuations of pressure in the reaction system were measured at various temperatures. Chemical and x-ray analysis, hardness testing, microscopic examination, and workability testing of the reactants were carried out. (Rev. Metal Lit., (June 1964))

35949 SELTENE METALLE. BAND II. INDIUM, LITHIUM, MOLYBDAN, NIOB, PLATINMETALLE, RADIUM, RHENIUM, RUBIDIUM, SELEN, SELTENE ERDEN, SILIZIUM, SA SKANDIUM. (Rare Metals. Volume II. Indium, Lithium, Molybdenum, Niobium, Platinum Metals, Radium, Rhenium, Selenium, Rare Earths, Silicon, and Scandium). W. Schreiter. Leipzig, VEB Deutscher Verlag für Grundstoffindustrie, 1961. 440p.

The data available on the properties, occurrence, ore processing, fabrication, and the range of application of the rare metals In, Li, Mo, Nb, Ru, Rh, Pd, Os, Ir, Pt, Ra, Re, Se, rare earths, Si, and Sc are compiled. (J.S.R.)

35950 SELTENE METALLE. BAND III. TANTAL, TELLUR, THALLIUM, THORIUM, TITAN, URAN, VANADIUM, WOLFRAM, YTTRIUM, ZIRKONIUM. (Rare Metals. Volume III. Tantalum, Tellurium, Thallium, Thorium, Titanium, Uranium, Vanadium, Tungsten, Yttrium, Zirconium). W. Schreiter. Leipzig, VEB Deutscher Verlag fur Grundstoffindustrie, 1962. 428p.

The data available on the properties, occurrence, ore processing, fabrication, and the range of application of the rare metals Ta, Te, Tl, Th, Ti, U, V, W, Y, and Zr are compiled. (J.S.R.)

35951 BERYLLIUM ALLOYS. Thomas Raine and James Alan Robinson (to Associated Electrical Industries, Ltd.). U. S. Patent 3,145,098. Aug. 18, 1964. Priority date June 27, 1961, Great Britain.

A ternary Be alloy is described which has improved mechanical properties while retaining most of the corrosion resistance to hot CO_2 of binary Be alloys containing 0.05 to 3% Ca. The ternary alloy comprises 0.1 to 3% Ca and 0.1 to 2% of either Zr, Nb, V, or Ti. Some data are given on the mechanical properties at 600°C and corrosion by CO_2 at 700°C of a Be–0.5% Ca–0.5% Zr alloy as compared with a Be–Ca alloy. (D.L.C.)

Corrosion

Refer also to abstracts 35497, 35552, 35637, and 36817.

35952 (AWRE-O-45/64) THE OXIDATION OF RARE EARTH METALS. PART I. BULK MATERIALS. W. Edmondson, K. Goodhead, and P. M. S. Jones (United Kingdom Atomic Energy Authority. Weapons Group. Atomic Weapons Research Establishment, Aldermaston, Berks, England). July 1964. 32p.

The kinetics of oxidation of a series of rare earth metals were investigated. The initial stages of the oxidation conform to a diffusion-controlled reaction in which oxygen molecules or O_3 ions diffuse through the oxide film to react at the buried metal surface. Considerable rate variations occur between different batches of the same metal due to changes in the temperature-independent factor. This is attributed to differences in the grain structure of the metals, which may affect the diffusion barrier properties of the oxide layer. (auth)

35953 (BM-RI-6359) HIGH-TEMPERATURE CORROSION STUDIES. A SENSITIVE VOLUMETRIC APPARATUS FOR DETERMINING GAS-SOLID REACTION KINETICS. Robert M. Doerr and Charles C. Myers (Bureau of Mines. Rolla Metallurgy Research Center, Mo.). June 1963. 15p.

An apparatus was developed for determining the kinetics of gas-solid reactions at high temperatures by measuring the volume of gas consumed with respect to time. The apparatus consists essentially of a horizontal precision-bore glass tube connecting a small reaction chamber in a furnace to a large constant-temperature reservoir. A drop of mercury in the tube separates the two sides of the system and serves as an indicator that moves at a speed proportional to the rate of gas consumption. The sensitivity of the apparatus depends inversely on both the density of the gas in the system and the cross-sectional area of the tube; with a tube having an area of 0.079 cm^2, the sensitivity for oxygen at 308°K and 0.5 atm is 20 cm/mg. The reproducibility of data with the volumetric apparatus is good. (auth)

35954 (DP-911) ALUMINUM CORROSION IN SUBCRITICAL AND ZERO POWER CRITICAL REACTORS. Mack E. Bergstresser (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). July 1964. Contract AT(07-2)-1. 11p.

Pitting and galvanic corrosion of aluminum in low temperature (<100°C) water during service in subcritical and zero power nuclear reactors was investigated. It was found that high purity water or the addition of chromates as inhibitors will minimize the corrosion rates. (auth)

35955 (MSAR-60-34) EFFECT OF 1200°F SODIUM ON AUSTENITIC AND FERRITIC STEELS. THERMAL SHOCK, NITRIDING, STRESSED CORROSION, [AND] UNSTRESSED CORROSION. Bi-Monthly Progress Report No. 3, November–December 1959. (MSA Research Corp.,

Callery, Penna.). Mar. 22, 1960. Contract AT(11-1)-765. 24p.

The test loop for the corrosion studies (stressed and unstressed specimens) is under construction. Stepwise procedures for specimen treatment, preparation, installation and removal from the loop, and testing both before and after exposure are discussed. The design of the nitriding loop was completed and construction started. The specimen preparation is identical to that of the corrosion study. Loop preparation and operational procedures for both experiments are given. The thermal shock loop is being transferred by the Navy to the AEC. (auth)

35956 (MSAR-64-93) EFFECT OF HIGH-TEMPERATURE SODIUM ON AUSTENITIC AND FERRITIC STEELS. PHYSICAL PROPERTIES OF MATERIALS. Progress Report No. 47, July 1964. (MSA Research Corp., Callery, Penna.). Aug. 14, 1964. Contract AT(11-1)-765. 19p.

The effects of high temperature reactor grade sodium, and normally anticipated contaminants, upon Type 316 stainless steel and $2\frac{1}{4}$ Cr–1 Mo steel are studied. For comparison, the physical properties of these same materials were also determined in air and helium. The test temperatures selected were 1200°F for the austenitic and 1100°F for the ferritic alloy. The contaminants to be intentionally introduced into the sodium after the reactor grade sodium tests were completed are oxygen, carbon, and nitrogen. The types of tests selected for revealing any possible effects of the environments upon the materials were tensile, creep, creep-to-rupture, fatigue and impact-strength. (auth)

35957 (NAA-SR-7502) COMPATIBILITY OF URANIUM CARBIDE FUELS WITH CLADDING MATERIALS. P. E. Elkins (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Aug. 1, 1964. Contract AT-11-1-GEN-8. 59p.

Compatibility experiments were conducted, as part of the Advanced Sodium Cooled Reactor Program, to determine the compatibility limitations of uranium carbide fuels with several cladding materials, both in a sodium environment and in direct contact. Hypostoichiometric uranium monocarbide was found to be compatible with Type 304 stainless steel, Nb–1 wt % Zr, and 3Z1, under conditions of loosely fitted fuel specimens in capsules of the cladding materials in question, either in the presence or absence of a sodium bonding medium. At temperatures below 1800°F, neither uranium nor carbon was transferred by the sodium to these cladding materials. Although no significant contact reactions were observed below 1600°F, under practical conditions of intimate contact after long-term irradiations, liquid- or solid-state reactions would be expected between the metallic uranium phase and cladding materials. With stainless steel claddings, the fuel surface must be restricted to temperatures well below the lowest iron–uranium eutectic temperature of 1340°F. Based on tests up to 6000 hr, hyperstoichiometric UC without a liquid metal bonding medium is compatible, up to 1600°F, with the three cladding materials to the extent that the observed reactions, even at 1600°F, were localized and limited in depth. However, in a sodium environment, this fuel is incompatible with Type 304 stainless steel by reason of the high carbon activity of hyperstoichiometric UC, the effective carbon transfer path offered by the sodium, and the carburizing potential of stainless steel. The resultant embrittlement of the stainless steel renders this system unsuitable for reactor operation. Compatibility tests with Nb–1 wt % Zr and 3Z1 capsules containing carbon-saturated sodium, used in order to obtain maximum carburization rates, exhibited satisfactory compatibility below 1600°F. At higher temperatures, 1800 and 2000°F, carburization rates were excessive, with evidence in some cases of accelerated effects caused by spalling of the carbide layer. Hastelloy N, Nichrome V, and all high-chromium steels examined were susceptible to carburization, and are unsuited for use with hyperstoichiometric UC unless an effective and reliable carbon barrier is developed. (auth)

35958 (SRIA-126) HIGH-TEMPERATURE OXIDATION AND NITRIDATION OF NIOBIUM IN ULTRAHIGH VACUUM. Quarterly Report No. VI, April 1–June 30, 1964. R. A. Pasternak (Stanford Research Inst., Menlo Park, Calif.). July 15, 1964. Contract AT(04-3)-115. 20p.

The sorption of N_2 by Nb at 1425 to 1635°C and 0.48 to 6 microtorr is measured. The sorption of O_2 by Nb is measured over a wide range of temperatures above room temperature, again at low pressures. The effects of dissociation of O_2 on the hot Nb surfaces are studied. (T.F.H.)

35959 MINIMIZING CORROSION IN URANIUM EXTRACTION SOLUTIONS BY APPLICATION OF ANODIC PROTECTION. F. P. A. Robinson and L. Golante (Univ. of the Witwatersrand, Johannesburg). Corrosion, 20: 239t-44t(Aug. 1964).

Anodic protection was applied to certain special alloys following an investigation into their anodic polarization characteristics in 0.1% HNO_3 + 5% HCOOH + 20% NH_4F solution saturated with SO_2. The effectiveness of this method of corrosion prevention was confirmed by the large reduction in corrosion rate. In addition, intercrystalline corrosion, knifeline attack, and weld corrosion were appreciably reduced on application of this technique. (auth)

35960 STUDIES OF THE REACTION OF NIMONIC-75 WITH CO_2. Oystein Kalvenes, Kristian Piene, and Per Kofstad (Central Inst. for Industrial Research, Blindern, Oslo). Corrosion Sci., 4: 211-20(June 1964).

The reaction of Nimonic-75 with CO_2 (760, 10, 0.1, and 0.01 torr) in the temperature range 750 to 1050°C was studied. The reaction leads to surface oxide formation (Cr_2O_3 and $NiCr_2O_4$) and decarburization. Oxide formation is favored at the higher CO_2 pressures, and the scale has a protective effect under these conditions. At the lower CO_2 pressures the amount of oxide formed is smaller and appears to have little protective effect. Under these conditions decarburization predominates and the rate of decarburization is determined by the rate of diffusion of carbon in the alloy. The decarburization reduces the ultimate tensile strength of Nimonic-75. At low pressure chromium also evaporates from the alloy. (auth)

35961 OXIDATION OF SEVERAL LANTHANIDE ELEMENTS. W. L. Phillips, Jr. (E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.). J. Less-Common Metals, 7: 139-43(Aug. 1964).

The oxidation rates of cerium, praseodymium, neodymium, samarium, gadolinium, terbium, and holmium were measured at elevated temperatures. All elements oxidized according to the linear weight-gain law. All oxides formed were of the Me_2O_3 type. The linear scaling rates and the activation energy were the same for all elements when measured at the same homologous temperature. (auth)

Fabrication

Refer also to abstract 36797.

35962 (AD-434397) REFRACTORY ALLOY FOIL ROLLING DEVELOPMENT PROGRAM. A STATE-OF-

THE-ART SURVEY. Interim Report No. 1, June 15–September 15, 1962. (Du Pont de Nemours (E. I.) & Co. Metals Center, Baltimore). Contract AF33(657)-8912. 128p.

The state-of-the-art of the rolling of niobium, tantalum, and tungsten base alloys to foil is reviewed. Since the rolling of foil requires control of the entire processing sequence, consolidation, sheet rolling, properties of sheet, and factors such as fabricability and stage of development have been analyzed. Alloys of niobium, tantalum, and tungsten have been recommended as candidates for rolling to foil on the remainder of the program. (auth)

35963 (BMI-1675) OXIDE-MATRIX DISPERSIONS UTILIZING COATED-PARTICLE FUELS. M. Clifford Brockway, Donald J. Bowers, and Winston H. Duckworth (Battelle Memorial Inst., Columbus, Ohio). July 14, 1964. Contract W-7405-eng-92. 22p.

Major problems associated with dispersing oxide vapor-coated fuel particles in oxide matrices were solved by pelletizing techniques. Damage to coated particles during mixing and compacting of fuel dispersions was minimized. Coating failures caused by matrix shrinkage during sintering or by matrix crack propagation were avoided by incorporating void-producing burnout layers around the dispersed coated particles. An unresolved problem was the thermal degradation of vapor coatings during matrix sintering to 1600°C. As a result the most retentive dispersions released several hundred ppm of ^{133}Xe during heating after neutron activation, compared with the release of only a few ppm exhibited by undispersed coated fuel. The proposed solution is to utilize a BeO matrix powder sinterable at lower temperatures. Limited effort was devoted to preparing fuel dispersions from sinterable-powder-coated UO_2 rather than from vapor-coated UO_2. In this approach the objective was a dense, continuous, impermeable BeO matrix which would provide oxidation resistance and fission-product retention. The best fuel dispersions of this type exhibited ^{133}Xe release of about 400 ppm when heated to 1150°C following neutron activation. The incomplete success of the approach was attributed to lamination defects in the BeO matrix which might be eliminated by further variations in the procedure of molding fuel dispersions. (auth)

35964 (LA-2104) FABRICATION OF PLUTONIUM INGOTS FROM PLUTONIUM TURNINGS. Karl W. R. Johnson (Los Alamos Scientific Lab., N. Mex.). Dec. 1, 1956. Contract W-7405-eng-36. 17p.

Kilogram quantities of delta-stabilized and pure plutonium turnings were cast directly into ingots of normal quality with high yields. The equipment and process used are described. (auth)

35965 (LA-2113) PREPARATION OF PLUTONIUM SHEET BY EXTRUSION. W. D. McNeese (Los Alamos Scientific Lab., N. Mex.). Jan. 17, 1957. Contract W-7405-eng-36. 14p.

Plutonium sheet of uniform thickness and good surface was made by the extrusion of a tube that was then split and flattened. The equipment and operating conditions for making sheet 0.005 to 0.055 in. thick with areas up to 24 $in.^2$ are described. (auth)

35966 (LA-2297) THE INJECTION CASTING OF PLUTONIUM. J. W. Anderson (Los Alamos Scientific Lab., N. Mex.). Jan. 1959. Contract W-7405-eng-36. 35p.

Plutonium metal was injected into cold metal molds to form castings with thin walls. The operation is performed in a vacuum chamber, using an inert gas as the injecting medium. Sound pieces free of gas cavities can be made using either pure or delta-stabilized plutonium. The equipment and techniques used to cast a typical thin section piece in the form of a 6 in. diameter, 45° cone are described. (auth)

35967 (ML-TDR-64-175) PRESSURE-BAKED GRAPHITE MATERIALS. Glen Stecker (Great Lakes Research Corp., Elizabethton, Tenn.). June 1964. Contract AF33(657)-11738. 68p.

The isostatic pressure baking process is investigated as a means for fabricating graphites. Using a standard mixture of graphite flour, thermal furnace black, and coal tar pitch, the optimum process conditions within the capability of the apparatus used were determined. Graphite density of 1.91 g/cc, flexural strength of 3000 psi, and compressive strength of 9000 psi was obtained. Other aggregates and binders were screened, using the above optimum process conditions. An isotropic carbon aggregate, with thermal furnace black and coal tar pitch, resulted in a graphite having a density of 1.95 g/cc, flexural strength of 6400 psi, and compressive strength of 14,000 psi. Graphite properties were essentially isotropic. (auth)

35968 (NAA-SR-9988) UC FUEL ELEMENT DESIGN AND FABRICATION. W. Draganchuk (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Aug. 1, 1964. Contract AT-11-1-GEN-8. 82p.

Uranium monocarbide shows considerable potential for use as a fuel in high-temperature, high-power-density, power reactors. A process for fabricating sodium-bonded uranium carbide fuel elements was developed for sodium–graphite reactors. The feasibility of the process was demonstrated by fabricating full-scale sodium-bonded fuel elements for installation in a reactor core. Following preliminary design and development efforts, ten sodium-bonded uranium carbide hypostoichiometric fuel elements were fabricated for installation in the Hallam Nuclear Power Facility. The development and fabrication of sodium-bonded, stainless steel-clad UC fuel elements was the first accomplishment of this type reported. Processing of melt stock, and fuel rod fabrication and testing, including a process for reclaiming fuel from rejected fuel rods without having to remelt, are discussed in detail. (auth)

35969 (NAA-SR-Memo-9411) COLD COMPACTING OF UO_2 + ZrH_2 FUEL PELLETS FOR CRITICAL EXPERIMENTS. W. M. Jones (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Jan. 13, 1964. Contract [AT(11-1)-Gen-8]. 39p.

A total of 22,284 fuel pellets were fabricated for the SNAP Critical Assembly. These pellets were cold pressed from granulated material consisting of 10 wt % highly enriched ceramic grade UO_2 and 90 wt % ZrH_2. A portion of these pellets was made with an addition of 1.0 to 6.0 wt % HfH_2, 0.1 to 0.6 wt % Eu_2O_3, (0.3 wt % Eu_2O_3–3 wt % HfH_2), (0.6 wt % Eu_2O_3–6.0 wt % HfH_2). The pellets were compacted on an automatic press (Stokes) at 35 tsi and yielded approximately 72 to 75% of the theoretical densities of the mixed powders. Difficulty was experienced in pelletizing the UO_2–ZrH_2 as blended. The material was, therefore, granulated, coated with stearic acid (0.5 wt %) to provide lubricant for the die during automatic compaction. Treatment of the UO_2–ZrH_2 mix for granulation consisted of compacting the mix at 12 tsi into briquettes. The pressed compacts were broken into small bits and then

fractioned to −16 + 50 mesh granules. An application of 0.4 wt % clear lacquer was applied to each pellet to increase their resistance to shock and chipping. The composition of each type pellet fabricated was identified by color coding using vertical lacquer stripes painted on each pellet. (auth)

35970 (NCSC-2663-17) URANIUM INTERSTITIAL PHASES. Quarterly Report, June 1964. J. V. Hamme, R. F. Stoops, and G. S. Sheffield (North Carolina State Coll., Raleigh). Work Performed under United States–Euratom Joint Research and Development Program. Contract AT (40-1)-2663. 17p. (EURAEC-1156)

Specimens of $U(C_{0.75}O_{0.25})$ were produced using graphite powder and milled UO_2 powder pressed into pellets and reacted at 1800°C in a CO atmosphere of approximately 100 microns of mercury pressure. The effect of milling the UO_2 was small, but apparently increased the reaction rate, making control of the composition of the final U(C,O) product difficult. Specimens of U(C,O) were ground and the powders hot pressed under equilibrium CO pressure conditions at 1700 to 1800°C. In these hot pressing experiments a maximum density of 12.7 grams per cubic centimeter was obtained (94% of theoretical density) if the small amount of UO_2 present is considered. X-ray diffraction analyses showed that the composition of specimens did not change during hot pressing. (auth)

35971 (NP-14177) UNA MAQUINA AUTOMATICA DE SOLDAR PARA SELLAR ELEMENTOS COMBUSTIBLES CILINDRICOS. Informe No. 104. (An Automatic Welding Device for Cylindrical Combustible Elements. Report No. 104). Oscar Wortman (Argentina. Comision Nacional de Energia Atomica, Buenos Aires). 1964. 11p.

A device was designed and constructed to weld aluminum-clad cylindrical fuel elements. All of the welding operations of the device are automated in order to produce reproducibility and leak tightness. The details and characteristics of the welded joints obtained are reviewed. (tr-auth)

35972 (NP-14193) DEVELOPMENT OF VERY HIGH-STRENGTH BERYLLIUM WIRE. Bimonthly Report No. 3, April 6–June 6, 1964. E. A. Murphy and R. G. O'Rourke (Brush Beryllium Co., Cleveland). Contract NOw-64-0162-c. 31p.

A process to produce high-strength fine beryllium wire is developed. Material chemistry for 5% copper–beryllium and 0.48% iron–beryllium alloys is listed. The beryllium–iron alloy was found not adaptable for the warm-drawing technique. Drawability of the fine-grained materials was found to decrease with decreased grain size and increased oxide content. (auth)

35973 (EURAEC-1023) SURVEY OF RESIDUAL STRESSES CAUSED BY THE VERTICAL UPWARD WELDING METHOD. Quarterly Report No. 9, January 1 to March 31, 1964. (Arcos, S. A., Brussels). Work Performed Under United States–Euratom Joint Research and Development Program. Contract 053-61-12-RDB. 74p. (A translation)

Measurements are made on a test-piece having a thickness of 100 mm. The report covers: measurement of the penetration in different points of the seam; recording of the temperatures at unequal distances from the seam in the course of welding, the reading of the exact position of the measurement couples, and the curve of the transversal distribution of temperatures; measurement of the surface stresses, as well as the control of the degree of release of these stresses; and measurement of the stresses in depth. (auth)

35974 USE OF A MIXTURE OF URANIUM OXIDES WITH SUPERSTOICHIOMETRIC OXYGEN CONTENT FOR THE PRODUCTION OF HIGH-DENSITY STOICHIOMETRIC DIOXIDE SINTERED PRODUCTS FOR NUCLEAR APPLICATIONS. I. Amato, R. L. Colombo, and A. M. Protti (FIAT, Turin). Mem. Sci. Rev. Met., 61: 485-8(June 1964). (In French)

Uranium oxide tablets with a superstoichiometric composition were sintered in a nitrogen atmosphere and then reduced in a hydrogen atmosphere. The same densities could be obtained in this way as those obtained by sintering stoichiometric uranium dioxide under hydrogen. A sintering temperature below 400°C was used. The characteristics of the samples obtained by this method are identical to those of samples produced by the traditional method. (tr-auth)

35975 MANUFACTURING CEMENTED TUNGSTEN CARBIDE PRODUCTS ON THE WEST COAST. C. L. Bohrer. Western Machinery Steel World, 55: No. 3, 52-5(Mar. 1964).

Cemented W–C was manufactured. Binder metal, CO, and Ti–C and Ta–C were added to increase hardness and reduce cratering of the finished product. Hot and cold pressing, sintering, techniques, furnaces, and temperature and pressure conditions are discussed. (Rev. Metal Lit., 21: June 1964)

35976 PROCESS FOR PREPARING SHAPED ARTICLES OF URANIUM SILICIDES. André Accary, Jacques Dubuisson, and Jacques Humbert (to Commissariat à l'Energie Atomique). U. S. Patent 3,142,533. July 28, 1964. Priority date May 29, 1959, France.

A process is given for preparing shaped articles of U_3Si_2, USi, USi_2, or USi_3. The process comprises introducing into a mold a mixture of U and Si powders of the desired proportions, compacting the mixture, heating the mixture under vacuum to between 450 and 675°C for at least one hour to react the U and Si, and setting the product at 1400 to 1500°C until it has the desired bulk density. (D.L.C.)

35977 LEAD-CONTAINING CERAMIC STRUCTURES FOR RADIATION SHIELDING. Herbert Schumann (to Firma Paul Rauschert Kommanditgesellschaft). U. S. Patent 3,145,184. Aug. 18, 1964. Priority date June 14, 1960, Germany.

A lead-containing material is described which can be sintered to form ceramic blocks or other structures. The material comprises 20 to 50% monazite sand and 50 to 80% lead oxide. Various modifications of the material are described. (D.L.C.)

Properties and Structure

Refer also to abstract 36554.

35978 (AD-431856) ELEVATED-TEMPERATURE TESTS OF CHROMIUM–TITANIUM–SILICON COATED F48 COLUMBIUM ALLOY BOLT AND NUT. Robert R. Wilcox (McDonnell Aircraft Corp., St. Louis). Contracts AF33(657)-11215 and BPSN-63-6899-7381-738103. 8p. (A-474)

A F-48 Nb alloy bolt and nut was subjected to four ½ hour cycles of exposure to 2500°F and cooled to room temperature. Prior to, and after each exposure the bolt and nut was weighed to 0.0001 gram and the weight gain determined. Following thermal cycling the bolt and nut was cross sectioned and metallographically examined, photo-

graphed, and coating thickness measured on the bolt shank and thread areas. Metallographic examination showed an equiaxed grain structure, resulting from recrystallization. Recrystallization began to replace the wrought structure, characteristic of the bolt before thermal cycling. Visual examination of the bolt and nut after the temperature exposures exhibited blemishes of chromium oxides on both bolt and nut. (auth)

35979 (AD-437255) EVALUATION OF RMSP TUNGSTEN SHEET. Quarterly Progress Report No. 3, January 1–March 31, 1964. (Solar, San Diego, Calif.). Apr. 20, 1964. Contract NOw-63-0786d. 55p. (ER-1399-3)

The evaluation of four as-received gages of RMSP tungsten sheets using standard acceptance test techniques was continued. Resistance-heated elevated tensile tests, 5T and 6T bend-transition determinations, recrystallization measurements, and chemical analysis for carbon and niobium were performed. The recrystallization measurements indicated that the recrystallization temperatures for the 0.010-, 0.020-, 0.060-, and 0.100-in. sheet, are 2450, 2500, 2525, and 2550°F respectively. Blanking, perforating, and deep-drawing investigations were conducted on each of the four sheet thicknesses. The results of the blanking and perforating studies indicate that these forming methods could be accomplished by control of sheet temperature, close-tolerance tooling, and control of forming procedures. Preliminary deep drawing of 0.060-inch sheet with a drop hammer was not successful. The deep drawing of 0.060-inch and 0.100-inch sheet was successfully accomplished with steel tooling and a hydraulic press. (auth)

35980 (AD-437500) IMPROVED OXIDATION RESISTANCE OF MOLYBDENUM BY ALLOYING WITH HAFNIUM. Final Report, November 1, 1961–August 31, 1963. (Colorado School of Mines Research Foundation, Inc., Golden). Sept. 3, 1963. Contract NOw-62-0305-d. 117p.

Preferential oxidation of a thermodynamically active metal component in a binary molybdenum-base alloy has been used to study the kinetics and mechanism of oxidation of that alloy and to determine the diffusion coefficient of the active component in the alloy. The system chosen was Mo–Hf. Diffusion coefficients for hafnium in molybdenum were independently predicted and agreed with those obtained by the selective oxidation method. (auth)

35981 (AD-439445) THERMODYNAMICS OF REFRACTORY COMPOUNDS OF BERYLLIUM (OXIDES, BORIDES, CARBIDES, AND NITRIDES): AN ANNOTATED BIBLIOGRAPHY. Jack B. Goldmann, comp. (Lockheed Missiles & Space Co., Sunnyvale, Calif.). Apr. 1963. Contract NOrd-17017. 103p. (SB-63-16)

References (248) on Be and its refractory compounds (oxides, borides, carbides, and nitrides) from 298.15 to 6000°K are given to reports and journals published from 1880 to 1962. (P.C.H.)

35982 (AD-603124) DEVELOPMENT OF IMPROVED STRENGTH AND OXIDATION RESISTANCE IN CHROMIUM COMPOSITES. Quarterly Report No. 1, March 17–June 16, 1964. W. A. Farrington (Bendix Corp. Bendix Products Aerospace Div., South Bend, Ind.). July 10, 1964. Contract NOw-0321-c. 23p.

The development of atmospheric-contamination resistance above 2200°F, room-temperature ductility, and high-temperature strength of chromium–ceramic composite materials was limited to a study of the effect of raw material impurities on oxidation resistance. The minor impurity content of raw magnesia used for preparation of a chromium–6% MgO composite appeared to effect a two-fold increase in the oxidation-weight-gain resistance of the material. (auth)

35983 (AMF-C-63-1) PHYSICAL AND CHEMICAL PROPERTIES OF URANIUM DIOXIDE SHAPES SINTERED BY LOW TEMPERATURE TECHNIQUE. D. S. Brearton (AMF Atomics (Canada) Ltd., Port Hope, Ont.). April 1963. 59p. (AECL-1953)

Development work aimed at the production of sintered UO_2 pellets on a commercial scale using a low temperature steam atmosphere cycle is described. A satisfactory cycle is recommended, together with results that indicate the effects of deviations from this cycle. (auth)

35984 (AWRE-O-51/64) ELECTRON-PROBE MICROANALYSIS OF ACTINIDE CERAMIC MATERIALS. G. V. T. Ranzetta and V. D. Scott (United Kingdom Atomic Energy Authority. Weapons Group. Atomic Weapons Research Establishment, Aldermaston, Berks, England). Aug. 1964. 25p.

The application of microanalysis to problems concerning segregation in mixed ceramic nuclear fuels is described. Illustrations are presented showing that microstructural evaluation by optical methods may be greatly aided by this technique and, moreover, that compositional changes in the sample may be monitored quantitatively on a microscale, which is not possible by any other method. (auth)

35985 (BM-RI-6498) INTERMETALLIC COMPOUNDS IN MAGNESIUM-RICH MAGNESIUM–ALUMINUM–ZIRCONIUM ALLOYS. R. L. Crosby and L. W. Higley, Jr. (Bureau of Mines, Rolla, Mo.). 1964. 15p.

Magnesium-rich magnesium–aluminum–zirconium alloys in the cast and in the extruded and heat-treated condition were studied to identify the phases present and to determine phase distribution. In cast alloys, two intermetallic compounds were identified: $ZrAl_2$ by x-ray diffraction; and $Mg_{17}Al_{12}$ by microscopical observation. Based on microscopical comparisons between the known phases in the cast structures and the phases in the structures of extruded and heat-treated rods, $ZrAl_2$ and $Mg_{17}Al_{12}$ were identified in the structure of the latter. The presence of these intermetallic compounds in rod specimens could not be confirmed by x-ray diffraction. $ZrAl_2$ was observed in the structure of extruded and heat-treated rod specimens containing as little as 0.01 wt % zirconium. The presence of aluminum restricts the solubility of zirconium in magnesium because of the strong tendency to form $ZrAl_2$. This intermetallic compound segregated in clusters of small particles in the matrix of cast alloys, and only slight improvement in distribution was noted when the alloying techniques were varied. (auth)

35986 (ERR-FW-049A) CURRENT INFORMATION ON THE REFRACTORY METALS. C. E. King (General Dynamics/Fort Worth. Div. of General Dynamics Corp., Fort Worth, Tex.). Dec. 1, 1962. Contract AF33(657)-11214. 80p. (AD-436333)

Data and information on the availability, cost, mechanical properties, modulus of elasticity, transition temperature, recrystallization, oxidation, oxidation coatings, and fabrication of Cr, Nb, Nb–Ti–Mo, Mo, Mo–Ti, Mo–Ti–Zr, Ta, Ta–W, and V are presented. 77 references are included. (P.C.H.)

35987 (EURAEC-1019) THE DEVELOPMENT OF A NEW DETERMINATION OF THE DUCTILE-BRITTLE TRANSITION TEMPERATURE. Quarterly Report No.

M-64-308-26150. Quarterly Report No. 10, January 1–March 31, 1964. H. C. van Elst (Netherlands. Nijverheidsorganisatie, TNO, The Hague). Work Performed under United States–Euratom Joint Research and Development Program. Contract 068-61-11-RDN. 66p.

The generation of stress waves similar to the stress endurance at the tip of a running brittle fracture by explosive and electrical means is studied. The conditions for the optimal magnetic interaction between carriers of the pulse discharge current of a condenser were analyzed. Compression stress waves with amplitude 80 kg/mm^2 and half time width 5 to 10 μsec could be generated by such interaction (using a 30 μF, 18 kv capacity). It is attempted to generate tensile stress waves in a similar way. An apparatus was constructed, which allows a small specimen (length 36 mm, diameter 6 mm, gage length 6 mm, gage width 3 mm) to be subjected to tensile stress waves with the aid of explosives. If desired this stress endurance can result in fracture. The development of a test method to determine the ductile-brittle transition temperature in steel with small specimens is discussed. The evaluation of stress wave damping by specimens of several steel types for one incident wave with peak pressure ca 150 kg/mm^2 and half time width ca 5 μsec as representative for brittle fracture was continued. Different lengths of the specimens in the temperature range 100 to 200°C were investigated. Copper specimens were tested which, contrary to the steel specimens and as expected, did not show a transition. Most of the energy absorption (ca 50%) probably results from an elastic damping. The temperature influence on the plastic contribution (ca 20%) is rather small. A compensating tendency of the changes of yield stress and deformation with temperature will occur as at lower (higher) temperatures the yield stress increases (decreases) and the deformation decreases (increases). When, e.g., the deformation process proceeds till fracture, larger differences will result from the early restriction of deformation (ca 2%) in the brittle region, while time becomes available for development of the deformation by shear in the ductile region. Then a deformation criterion, rather than an energy criterion, with temperature seems more relevant. (auth)

35988 (MSAR-64-81) EFFECT OF HIGH-TEMPERATURE SODIUM ON AUSTENITIC AND FERRITIC STEELS. PHYSICAL PROPERTIES OF MATERIALS. Topical Report No. 3. RESULTS OF PHYSICAL PROPERTY TESTS OF 2 ¼ Cr–1 Mo STEEL SPECIMENS IN SODIUM WITH HIGH AND LOW OXYGEN, AIR AND HELIUM ENVIRONMENTS AT 1100°F. R. C. Andrews and K. R. Barker (MSA Research Corp., Callery, Penna.). July 1964. Contract AT(11-1)-765. 96p.

The mechanical properties of 2¼ Cr–1 Mo steel were tested in 1100°F dynamic sodium systems having both high (330 ppm) and low (30 ppm) oxygen contents and air and helium environments. The number of cycles to failure in the cyclic, constant strain, fatigue testes at 1100°F in sodium were 5 to 16 times those in air. Tests in helium were the same as those in sodium. Rupture tests in sodium resulted in slightly less rupture strength than tests in air or helium. All specimens showed a decrease in rupture life after exposure for 4000 hours in sodium with either 30 or 300 ppm oxygen. The minimum creep rates were faster in sodium as compared to air and helium. The results suggest an earlier attainment on third-stage creep in the sodium and helium environments as compared to air. Tensile and yield strengths at 1100°F were reduced and ductility increased by exposure to sodium for 4000 hours without stress prior to testing in air or helium. Decarburization of 2¼ Cr–1 Mo specimens was experienced in both of the sodium environments with indication of high rates in sodium with high oxygen. It is believed that the helium environments contained dilute concentrations of oxygen that affected the test results. (P.C.H.)

35989 (ORNL-3661) INFLUENCE OF SEVERAL METALLURGICAL VARIABLES ON THE TENSILE PROPERTIES OF HASTELLOY N. H. E. McCoy (Oak Ridge National Lab., Tenn.). Aug. 1964. Contract W-7405-eng-26. 65p.

The tensile properties of Hastelloy N have been evaluated after various heat treatments. One vacuum-melted and four air-melted heats were studied. It was found that the vacuum-melted material exhibited good ductility after all heat treatments. Annealing the air-melted material to temperatures in excess of 2150°F brought about significant reductions in the minimum fracture strain exhibited by the alloy. Holding at temperatures of about 1600°F for an extended period recovered the fracture ductility. Aging material in the 1100 to 1200°F range that had been previously annealed at 2150°F brought about a significant reduction in the ductility. These changes in ductility occurred with very small changes in tensile strength. It is felt that these effects can be explained in terms of the formation of a brittle grain boundary layer along which a crack can propagate easily at elevated temperatures. Interrupting the continuity of this layer by overaging or cold working recovers good fracture ductility. The formation of this layer is associated with the presence of trace alloying elements. (auth)

35990 (ORNL-P-148) A THERMAL COMPARATOR APPARATUS FOR THERMAL CONDUCTIVITY MEASUREMENTS FROM 50 TO 400°C. T. G. Kollie, D. L. McElroy, R. S. Graves, and W. Fulkerson (Oak Ridge National Lab., Tenn.). [1964]. Contract [W-7405-eng-26]. 47p. (CONF-638-3)

From National Physical Laboratory Conference on Thermal Conductivity, Teddington, Eng., July 1964.

The experimental details, mathematical models, and typical data for a rapid comparative method for thermal conductivity measurements are presented. The method consists of measuring the temperature change of a small silver sphere after it is brought in contact with a small disk-shaped specimen which was initially at a higher temperature. This temperature change was calibrated in the range of 50 to 400°C by making measurements on samples of known thermal conductivity. Results at 75 and 300°C on uranium sulfide, thorium sulfide, uranium nitride, and uranium dioxide are presented to demonstrate the usefulness of the method. The accuracy of this technique was shown to be better than ±10% with a reproducibility of at least ±2.5%. Using known transport mechanisms for heat conduction in solids and the temperature dependence of the electrical conductivity, a means to judiciously extrapolate thermal conductivity data obtained between 50 and 400°C to higher temperature is presented. (auth)

35991 (ORNL-P-150) THERMAL PROPERTIES OF GRADE CGB GRAPHITE. J. P. Moore, T. G. Godfrey, and D. L. McElroy (Oak Ridge National Lab., Tenn.). [nd]. Contract [W-7405-eng-26]. 10p. (CONF-638-2)

Addendum to ORNL-3556.

From National Physical Laboratory Conference on Thermal Conductivity, Teddington, Eng., July 1964.

The thermal conductivity of CGB graphite was measured both normal (34 to 1015°C) and parallel (34 to 75°C) to the extrusion axis, using radial and longitudinal heat flow apparatuses. Electrical resistivity normal and parallel to the extrusion axis was also measured at 23 to 1000°C, and the electronic component of the thermal conductivity was calculated. The lattice component of the thermal conductivity

was determined and its relation with temperature found to agree with the predicted inverse relation. (D.L.C.)

35992 (TID-20878) ION MOBILITY IN MOLTEN SALTS. Progress Report, June 1, 1963–May 31, 1964. Richard W. Laity (Princeton Univ., N. J.). Contract AT(30-1)-2644. 14p.

Instruments for determining the diffusion mobility of ions in fused salts are developed. Experimental results are reviewed, including Ag^+ mobility in KCl, corrosion of Vycor and silica glass by alkali halides, and preparation of high-purity KCl–LiCl. (T.F.H.)

35993 (UCRL-10468(Rev.)) MECHANICAL BEHAVIOR OF SINGLE-CRYSTAL AND POLYCRYSTALLINE CESIUM BROMIDE. Lawrence D. Johnson and Joseph A. Pask (California. Univ., Berkeley. Lawrence Radiation Lab.). July 26, 1963. Contract W-7405-eng-48. 45p.

Plastic-deformation studies were made of cesium bromide (interpenetrating simple cubic structure), which exhibits no cleavage planes. Single crystals were found to be soft and ductile if they were favorably oriented relative to the loading axis to activate the {110} ⟨001⟩ slip systems. Kink bands were formed by applying a compressive load normal to a {100} plane. Cross slip was found to occur during deformation at all test temperatures. Tensile loads applied normal to {100} and {110} planes caused fracture along {110} planes, while compressive loads normal to {100} planes forced fracture along {112} planes. The ductility of polycrystalline cesium bromide was found to be limited because of the lack of five independent slip systems. The specimens with smaller grains showed less strain at fracture and greater work hardening than the larger-grain specimens. The mechanism of fracture was intergranular in tests up to 300°C. (auth)

35994 (UCRL-10899) THE EFFECT OF VERY HIGH PRESSURES ON THE MÖSSBAUER SPECTRUM OF Fe^{57} IN IRON METAL (thesis). Malcolm Foertner Nicol (California. Univ., Berkeley. Lawrence Radiation Lab. and California. Univ., Berkeley. Dept. of Chemistry). Aug. 1963. Contract W-7405-eng-48. 77p.

A velocity-sweep-type high-pressure Mössbauer spectrometer was developed for use at pressures to 150 kbar and greater. This spectrometer was used to study the effect of pressure on the Mössbauer spectrum of ^{57}Fe in metallic iron to a pressure presumably higher than 140 kbar. At pressures up to 120 kbar, a six-line spectrum characteristic of α-iron was observed. A seventh line appeared in the spectrum obtained at 140 kbar. This line was attributed to the appearance of the high-pressure phase of iron. The variation of the magnetic splitting of the Mössbauer spectrum in the α-iron phase compared favorably with results obtained at lower pressures by nuclear magnetic resonance. The experiment indicates that Mössbauer spectroscopy can be usefully applied to the study of magnetic materials at high pressures, and some additional experiments are suggested. (auth)

35995 (UJV-989/64) SURFACE AREA MEASUREMENTS OF URANIUM OXIDES. H. Landsperský and D. Jakeš (Československá Akademie Věd. Ústav Jaderného Výzkumu, Řež). [1963]. 33p.

Methods for the measurement of specific surface areas of UO_2 were investigated. A permeability method was selected as a rapid and simple control method, which could at the same time offer some information about pressing. Comparison of surface areas of pressed pellets by means of the BET method and permeability method showed that real surface area values (and therefore also calculated mean particle sizes) of the pressed powders do not correspond to values obtained by the BET method on powdered material, but that they are higher. Agreement of specific surface values measured by both methods was obtained only at porosities of $\varepsilon = 0.4$. In measuring surface areas of UO_3, it was never possible to find a porosity region, in which the S_C value would be quite independent of porosity. Comparison of S_C and S_{HD} values of UO_3 samples showed good agreement when UO_3 samples were prepared at temperatures 450°C. (P.C.H.)

35996 THE USE OF RUBBER IN PROTECTION AGAINST RADIATION. Comit. Nazl. Energia Nucl., Notiziario, 10: 51-3(1964).

The possibility of using rubber as a radiation protection material is discussed, and the advantages offered by rubber are compared to other protection materials. (Excerpta Med., Sect. 23, 1: No. 7, July 1964)

35997 PLASTIC DEFORMATION OF POLYCRYSTALS AND IMPERFECT MONOCRYSTALS OF α URANIUM BY CREEP AT MEDIUM TEMPERATURES (325 TO 480°C). Pierre Grenier, Robert Sassi, and Paul Lacombe (Ecole des Mines, Paris). Compt. Rend., 258: 6414-17(June 29, 1964). (In French)

The micrographic observation of uranium polycrystals and monocrystals subjected to creep and the examination of the deformation-time curves showed that the deformation of the metal at medium temperatures is controlled by a single and unique mechanism instigating the deflected slip. (tr-auth)

35998 ANOMALY OF GALVANOMAGNETIC PROPERTIES IN GADOLINIUM. N. A. Babushkina. Dokl. Akad. Nauk SSSR, 155: 1290-2(Apr. 21, 1964). (In Russian)

Recent anomalies, such as the appearance of a minimum of the coercive force at 210°K in polycrystalline specimens of Gd, have been discovered. In order to understand these phenomena, changes in the electric resistance of Gd specimens exposed to a longitudinal magnetic field up to 17000 oersted were measured at temperatures between 4 and 400°K. The measurements were carried out with a high-sensitivity galvanometer by the compensation method, using a cryostat at the low temperatures. Instead of the expected maximum at the Curie point, 3 maxima were observed: the normal one at 290°K corresponds to the transition at the Curie point; the maximum at 240°K is probably due to a minimum in the anisotropic energy at that temperature; the cause of the third maximum is not yet clear. The experiments were carried out with specimens containing 98.9, 99.7, and 99.9% Gd. After annealing at 1100°C for 10 hours, the residual resistance decreased but the value and the temperature dependence of the galvanomagnetic effect remained unchanged. The behavior of the galvanomagnetic effect was found to be independent from the purity of the test specimen. Resistance and magnetic susceptibility measurements in the paramagnetic range indicated that the system follows the Curie-Weiss law, with a Curie point at 310°K. (TTT)

35999 ELASTIC PROPERTIES OF MULTICOMPONENT TITANIUM ALLOYS WITH MOLYBDENUM, VANADIUM AND NIOBIUM. S. G. Fedotov and O. K. Belousov. Dokl. Akad. Nauk SSSR, 155: 1387-90(Apr. 21, 1964). (In Russian)

The modulus of elasticity and shear modulus as a function of concentration in annealed and quenched ternary systems Ti–Mo–V, Ti–Mo–Nb, Ti–V–Nb, and the quaternary Ti–Mo–V–Nb were investigated. The test specimens, containing 1:1 and 1:1:1 weight % ratios of the alloying

additions to Ti, were prepared by melting in an arc furnace under Ar atmosphere. The elastic constants were measured using both specimens annealed at 600°C and quenched from 900°C. Comparison of the results revealed that the elastic properties of the annealed specimens, plotted as a function of the concentration, exhibit identical behavior; this was anticipated, in view of the similarity of the behavior of Ti with the alloying elements, indicated by the phase diagrams of the systems. The elements, introduced into the alloy either separately or together, lowered the modulus of elasticity and the shear modulus of the α-alloy in the $\alpha + \beta$ region. Transition into the single-phase β-solid solution was responsible for the minimum observed in this region; further alloying additions to the homogeneous β-solid solution resulted in the increase of elastic properties. The value of the elastic properties of α-Ti is at least twice higher than that of β-Ti; the alloying additions lowered these values in the case of α-Ti but had an opposite effect on β-Ti. The differences in the solubility of the elements in α-Ti are responsible for difference in the elongation of the alloys and in the concentration dependence of the induced changes. It was concluded that the chemical interaction, as expressed in the phase diagrams, is chiefly responsible for the changes in the elastic properties of these Ti alloys. (TTT)

36000 CHARACTERISTICS OF THE KINETICS OF POLYMORPHOUS TRANSFORMATION OF ZIRCONIUM DIOXIDE DURING COOLING. B. Ya. Sukharevskii, B. G. Alapin, and A. M. Gavrish (Scientific Research Inst. of Refractories, Academy of Sciences, Ukrainian SSR). Dokl. Akad. Nauk SSSR, 156: 677-80(May 21, 1964). (In Russian)

It is generally assumed that diffusionless (martensite) transformations proceed with either athermal or isothermal kinetics. Work was carried out for the purpose of showing that at least in the case of the phase transformation of zirconium dioxide, there is no fundamental difference between these two types of transformations. The experimental evidence of the diffusionless character of the polymorphous transformation of ZrO_2 is presented. In the beta to alpha transformation of zirconium dioxide, the kinetics of diffusionless transformation change during supercooling from isothermal to athermal kinetics. This phenomenon was studied in detail on samples of the beta phase of ZrO_2. The kinetics of the beta to alpha transformation were studied during cooling. It was found that isothermal kinetics result from defects obstructing the motion of the dislocations of the transformation. When the number of obstructions is small, athermal kinetics are produced. (OTS)

36001 DIFFUSION OF BORON AND CARBON IN REFRACTORY TRANSITION METALS. A. P. Epik. Dopovidi Akad. Nauk Ukr. RSR, No. 1, 67-70(1964). (In Ukrainian)

The effects of diffusion conditions of carbide and boride on the structure, phase composition, and case depth of Ti, Zr, Nb, Ta, Mo, and W were investigated. Characteristics of the coatings as determined by metallography, x-ray diffraction and chemical analysis were made. (Rev. Metal Lit., 21: (June 1964))

36002 THERMAL DECOMPOSITION OF EUROPIUM HYDROXIDE. Robert C. Rau and W. J. Glover, Jr. (General Electric Co., Cincinnati). J. Am. Ceram. Soc., 47: 382-7(Aug. 1964).

The thermal decomposition of europium hydroxide in an air atmosphere was investigated by means of weight-loss measurements, infrared spectroscopy, x-ray diffraction analysis, and electron microscopy. The studies showed that $Eu(OH)_3$ decomposed at temperatures between 225 and 300°C into EuOOH, which was stable up to about 425°C. Between 435 and 465°C this compound decomposed into cubic Eu_2O_3, which was stable until its inversion to the high-temperature monoclinic form. X-ray diffraction data were collected for $Eu(OH)_3$ and EuOOH and showed that the trihydroxide has a hexagonal crystal structure and the oxyhydroxide is possibly orthorhombic. The $Eu(OH)_3$, EuOOH, and cubic Eu_2O_3 powders contained particles up to several microns in size consisting of agglomerates of crystallites in the size range 200 to 400 Å. The single monoclinic Eu_2O_3 sample studied contained crystallites whose average size was greater than 2000 Å. (auth)

36003 RELEASE OF XENON FROM URANIUM CARBIDE AT LOW TEMPERATURES. Allan Auskern (Brookhaven National Lab., Upton, N. Y.). J. Am. Ceram. Soc., 47: 390-4(Aug. 1964). (BNL-7429)

The release of xenon from lightly irradiated uranium monocarbide powders was studied in the temperature range 150 to 975°C. Release in this range is much higher than that calculated by extrapolating high-temperature diffusion data. The kinetics of the release agree with a model in which the xenon in the first three or four unit cells is released over a range of activation energies. (auth)

36004 THERMAL EXPANSION MEASUREMENTS ON THORIA AND HAFNIA TO 4500°F. Basil Ohnysty and F. K. Rose (Solar, San Diego, Calif.). J. Am. Ceram. Soc., 47: 398-400(Aug. 1964).

Equipment for measuring thermal expansion to 4500°F is described. Linear thermal expansion to 4500°F was measured on thoria and hafnia. Average coefficient of linear expansion from 75 to 4500°F for thoria was 6.05×10^{-6} per °F; for stabilized hafnia with 10 wt % Y_2O_3 additions it was 6.33×10^{-6} per °F, and with 15 wt % Y_2O_3 additions it was 6.27×10^{-6} per °F. (auth)

36005 THERMAL EXPANSION OF URANIUM SESQUICARBIDE. R. Méndez-Peñalosa and R. E. Taylor (Atomic International, Canoga Park, Calif.). J. Am. Ceram. Soc., 47: 416-17(Aug. 1964).

The thermal expansion of stoichiometric U_2C_3 was determined to its decomposition temperature and the effects of the decomposition to UC and UC_2 were observed. The mean thermal expansion coefficient increased smoothly to 1700°C and then increased rapidly. This was most pronounced at about 1780°C, at which temperature a marked increase in specimen length was observed without a corresponding increase in temperature. This expansion was thought to be caused by the onset of the decomposition reaction $U_2C_3 \rightarrow UC + UC_2$, which begins at about this temperature. (P.C.H.)

36006 SOME EXPERIMENTAL OBSERVATIONS IN THE CESIUM-GRAPHITE SYSTEM. F. J. Salzano and S. Aronson (Brookhaven National Lab., Upton, N. Y.). J. Inorg. Nucl. Chem., 26: 1456-8(Aug. 1964). (BNL-7617)

Studies on the Cs-graphite system are reported. Kinetic and equilibrium studies indicate that a new phase, hitherto unreported, is present. Also, the mechanism of reaction between Cs and graphite was partially clarified. Hysteresis was observed in the two-phase region between $C_{16}Cs$ and $C_{24}Cs$ (180-188°C). A kinetic study of the rate of decomposition of the Cs-graphite compound, C_8Cs, in vacuo, indicated that the decomposition proceeds in distinct stages. Rates of decomposition were obtained over the temperature range 400-600°C. (P.C.H.)

36007 INTERPRETATION OF THE X-RAY POWDER PATTERN OF β-UO_3. P. C. Debets (Reactor Centrum

Nederland, Petten, Netherlands). J. Inorg. Nucl. Chem., 26: 1468-70(Aug. 1964).

The x-ray-powder pattern of β-UO_3 was investigated. Samples of β-UO_3 were prepared from ammonium diuranate or uranyl nitrate by calcination at 500°C. Sin^2-values were calculated on the basis of a monoclinic unit cell with the following dimensions: a = 10.34 + 0.01; b = 14.33 ± 0.01; c = 3.910 ± 0.004 Å; β = 99.03° ± 0.01°. The space group is $P2_1(C_2^2)$ or $P2_1/m(C_{2h}^2)$. The structure consists of pseudo-hexagonal layers at y = 0 and $\frac{1}{2}$ with U-U distances of 3.9 Å. The layers are separated by sets of almost linear chains at y = $\frac{1}{4}$ and $\frac{3}{4}$, parallel to the c-axis, at distances of 5.17 Å from one another. (P.C.H.)

36008 DISSOLUTION OF REFRACTORY PLUTONIUM DIOXIDE. J. M. Cleveland (Dow Chemical Co., Golden, Colo.). J. Inorg. Nucl. Chem., 26: 1470-1(Aug. 1964).

The dissolution of refractory PuO_2 in HNO_3, HCl, and HBr was investigated. The results showed the highest percentage of dissolution in HBr. Because of the encouraging results obtained with hydrobromic acid, a program was undertaken to dissolve a large quantity of oxide residues in this acid. By continued repetition of the procedure used, a quantity of oxide containing more than 3000 g of Pu was dissolved, leaving a final residue containing less than 0.5 g of Pu, a yield of greater than 99.98%. (P.C.H.)

36009 REMARKS ON THE THERMAL DECOMPOSITION OF PLUTONIUM(IV) OXALATES. A. Glasner (Hebrew Univ., Jerusalem). J. Inorg. Nucl. Chem., 26: 1475-6(Aug. 1964).

The mechanism of the thermal decomposition of Pu(IV) oxalates as determined previously by others is evaluated and discussed. (P.C.H.)

36010 THE PALLADIUM–URANIUM PHASE DIAGRAM UP TO 25 AT.-% URANIUM. G. P. Pells (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Inst. Metals, 92: 416-18(Aug. 1964).

High-purity palladium–uranium alloys containing up to 25 at. % uranium were examined by means of metallography and x-ray diffraction. The terminal face-centered cubic δ phase undergoes two eutectoidal transformations: the first, at 13.5 at. % uranium and 694°C, gives two compounds, $Pd_{17}U_2$ and $Pd_{11}U_2$, and the second, at 15.5 at. % uranium and 1015°C, gives $Pd_{11}U_2$ and Pd_3U. The Pd_3U forms by peritectic reaction at 18.8 at. % uranium and 1440°C and exists over a small solubility range. The nominal compound Pd_4U forms by peritectic reaction at 21 at. % uranium and 1525°C; this also has a small solubility range. The compounds $Pd_{17}U_2$, $Pd_{11}U_2$, and Pd_3U have noncubic structures; Pd_4U has an ordered structure of the Cu_3Au type. The variation of electric resistivity with composition is given up to 15.5 at. % uranium. (auth)

36011 CLEAVAGE FRACTURE IN CAST MOLYBDENUM OF HIGH PURITY. H. R. Limb (Defence Standards Labs., Adelaide). J. Inst. Metals, 92: 423-6(Aug. 1964).

Cleavage surfaces produced in the birttle fracture of high-purity cast molybdenum are shown to vary greatly in appearance and in crystallographic relationship. Some similarities with cleavage surfaces produced in high-purity cast chromium were noted; in addition new types of characteristically marked cleavage surface were identified, viz. cleavage on (113) planes and on many planes of a ⟨113⟩ zone to give cylindrically shaped surfaces. (auth)

36012 THE EFFECT OF GRAIN SIZE AND COLD WORK ON THE TENSILE PROPERTIES OF ALPHA-URANIUM. D. M. R. Taplin and J. W. Martin (Oxford Univ.). J. Less-Common Metals, 7: 89-97(Aug. 1964).

The effects of grain size and of plastic deformation at 300°C on the tensile properties of commercial-purity uranium (total impurities <500 ppm) were investigated with particular reference to the ductile–brittle phenomenon. It was established that increasing amounts of cold work lower the transition temperature appreciably and that the effect of grain size is slight, whereby decreasing grain size lowers the transition temperature. The cleavage fracture stress σ_c, and grain size d, do not obey the predicted relationship $\sigma_c \propto d^{-\frac{1}{2}}$. It is considered that the criterion for brittle fracture in uranium is associated with the increasing predominance of the twinning mode of deformation with decreasing temperature. (auth)

36013 THE SYSTEM ZINC–TECHNETIUM-99. M. G. Chasanov, I. Johnson, and R. V. Schablaske (Argonne National Lab., Ill.). J. Less-Common Metals, 7: 127-32 (Aug. 1964).

The Zn–^{99}Tc phase diagram was studied by thermal, metallographic, x-ray, sampling, and effusion techniques. The solubility of technetium in liquid zinc is expressed by the empirical equations: (470–544°C) log (at.% Tc) = $6.431-7159T^{-1}$; (544–758°C) log (at.% Tc) = $9.413-15690T^{-1} + 4.979 \cdot 10^6T^{-2}$. Two intermediate phases were found in the system: $TcZn_8$ and another phase with a Zn–Tc atom ratio between 15 and 18. These phases decompose peritectically at 544 and 950°C, respectively. Mutual solubilities in technetium and zinc appear to be negligible. Technetium metal appears to be unattacked by molten cadmium at 500°C. (auth)

36014 CARBIDES OF FORMULA T_2MC. W. Jeitschko, H. Nowotny, and F. Benesovsky (Universität, Vienna and Metallwerk Plansee AG, Reutte/Tirol, Austria). J. Less-Common Metals, 7: 133-8(Aug. 1964).

The ternary compounds Zr_2TlC, Zr_2PbC, Hf_2TlC, and Hf_2PbC were prepared and examined. The crystal structure of these carbides was found to be isotopic with Cr_2AlC, H-phase. (auth)

36015 MICROPLASTICITY IN α-URANIUM. P. Feltham (Brunel Coll., London) and P. Ryder. J. Less-Common Metals, 7: 144-51(Aug. 1964).

Logarithmic stress-relaxation in α-uranium strips extended up to 5% at 200–386°K is shown to be controlled by a mechanism with an energy barrier of 1.0 ev, numerically equal to about 0.57 times the activation energy of self-diffusion. This result, in conjunction with analyses of the kinetics of debris formation by moving dislocations, as observed in thin foils of the metal by electron transmission microscopy, is consistent with a model in which relaxation arises from residual glide of screw dislocations in the prominent (010) [100] glide system, the dislocations being subjected to a frictional drag by vacancy generating jogs of the $\frac{1}{2}$[110] type. (auth)

36016 A NOTE ON THE INTERMETALLIC CHEMISTRY OF THE LATER TRANSITION ELEMENTS. W. Hume-Rothery (Oxford Univ.). J. Less-Common Metals, 7: 152-8(Aug. 1964).

Equilibrium diagrams of the later transition metals of the Second and Third Long Periods were examined systematically. It is shown that the body-centred cubic, close-packed hexagonal, and face-centred cubic phases have composition ranges whose boundaries appear to be controlled mainly by the Average Group Numbers of the alloys. Group Numbers of 6, 7, 8, 9, and 10 are allotted to the elements of Groups VIA, VIIA, VIIIA, B, and C, respectively, so that an equiatomic alloy of Mo and Ru has an AGN value of 7.0. Relations with the elements of the first transition series are discussed. (auth)

36017 PLUTONIUM–MAGNESIUM DIFFUSION. A. Van Craeynest and M. D. Calais (C.E.N.F.A.R., Fontenay-aux-Roses, France). Mem. Sci. Rev. Met., 61: 459-65(June 1964). (In French)

The diffusion of Pu in Mg was studied on couples of a biphase alloy (Mg saturated in Pu + precipitates rich in Pu) and pure Mg. The exact measurement of the concentrations was made with a Castaing microanalyzer. The solubility of Pu in Mg is between 10 and 25 wt %. The diffusion coefficients calculated by the Matano method fall between 5000 and 200×10^{-13} cm^2 sec^{-1} for temperatures between 540 and 420°C and at concentrations of the order of 1 at. %. (tr-auth)

36018 CONTRIBUTION TO THE STUDY OF THE PRECIPITATION OF IRON IN BERYLLIUM. R. Le Hazif, G. Donze, J. M. Dupouy, and Y. Adda (CEA, Saclay, France). Mem. Sci. Rev. Met., 61: 467-74(June 1964). (In French)

The solubility limits and the coefficients of diffusion of Fe in Be between 700 and 1100°C were determined with a Castaing microanalyzer using Be/Be–Fe alloy diffusion couples. The precipitation was studied as a function of the mode of quenching and the tempering temperature on alloys containing 0.2 to 1 wt % Fe. The precipitation is always produced first at the grain boundaries and then in the matrix with formation of a zone denuded of precipitates around the boundaries. Severe work-hardening produces homogeneous precipitation of $Be_{11}Fe$ in an orientation relaxation with the matrix. (tr-auth)

36019 GRAIN REFINING TEST OF CAST BERYLLIUM BY A COMBINATION OF MECHANICAL AND THERMAL TREATMENTS. G. Gasc and J. Barbier. Mem. Sci. Rev. Met., 61: 475-80(June 1964). (In French)

The results of tests carried out on coarse-grained cubic samples, 20 mm side length, in triaxial compression with anneals between 575 and 935°C and in uniaxial compression are reported. The ductility was highest for a temperature of 400°C. The recrystallization of Be produced multiple shapes and generally led to heterogeneous structures. Fairly good ductility in one direction was obtained because of marked preferred orientation. (auth)

36020 CERTAIN PROPERTIES OF "CERMETS" URANIUM DIOXIDE–MOLYBDENUM. I. Amato, R. L. Colombo, and A. M. Protti (FIAT, Turin). Mem. Sci. Rev. Met., 61: 481-3(June 1964). (In French)

The results of sintering tests between 1500 and 1800°C in hydrogen are reported for cermets composed of UO_2 powder and 5 to 30% Mo. Densities of 95 to 98% of the theoretical value were obtained. The electric conductivity increased with the Mo concentration. (auth)

36021 FATIGUE TESTS ON URANIUM AND SOME URANIUM ALLOYS. A. M. Barets and M. D. Francois. Mem. Sci. Rev. Met., 61: 553-4(July-Aug. 1964). (In French)

The method of iteration was used to determine the fatigue limit in tension and compression of unalloyed uranium and alloys $U–Mo_{1.5}$ and $U–Cr_{0.08}–Si_{0.05}–Zr_{0.06}$ in the as-cast condition: their respective values are approximately 10, 21, and 23 kg/mm^2. (auth)

36022 PREPARING INFILTRATED TUNGSTEN FOR EXAMINATION. Robert E. Matt and Isamu Yoshioka. Metal Progr., 85: No. 4, 95-6(Apr. 1964).

Metallographic examination was made to determine the grain structure and infiltration of silver in tungsten used for solid fuel rocket nozzles. The surface preparation technique that removes only a minimum amount of the Ag infiltrant is discussed. (Rev. Metal Lit., 21: (June 1964))

36023 ON THE RELATION BETWEEN HIGH-TEMPERATURE CREEP AND DIFFUSION IN NICKEL-BASE SOLID SOLUTIONS. I. DIFFUSION OF Ni^{63} AND Cr^{51} IN NICKEL–CHROMIUM ALLOYS. Kaizo Monma, Hajime Suto, and Hiroshi Oikawa (Tohoku Univ., Sendai). Nippon Kinzoku Gakkaishi, 28: 188-92(1964). (In Japanese)

Self-diffusion coefficients of nickel and chromium in nickel–chromium alloys containing 0 to 30 at. % of chromium were measured with a usual lathe sectioning technique at 1040 to 1300°C. Polycrystalline specimens having 1 to 4 mm grain size were used. In all alloys examined, chromium atom diffused more rapidly than nickel atom, and the ratio of diffusion coefficient of chromium to that of nickel was about 1.6 independent of the chromium content over the whole temperature range. Diffusion rates of both elements decreased slightly with increasing content of chromium. The frequency factors for nickel self-diffusion are 1.9, 3.3, 1.6, and 2.9 cm^2/sec, and the activation energies are 68.0, 70.2, 68.5, and 70.5 kcal/mole in alloys containing 0, 10.0, 19.9, and 29.7 at. % chromium, respectively. For chromium, self-diffusion in respective alloys, the frequency factors are 1.1, 1.4, 1.9, and 3.2 cm^2/sec, and the activation energies are 65.1, 66.5, 67.7, and 69.4 kcal/mole. (auth)

36024 ON THE RELATION BETWEEN HIGH-TEMPERATURE CREEP AND DIFFUSION IN NICKEL-BASE SOLID SOLUTIONS. II. DIFFUSION OF Ni^{63} AND Cu^{64} IN NICKEL-COPPER ALLOYS. Kaizo Monma, Hajime Suto, and Hi Hiroshi Oikawa (Tohoku Univ., Sendai). Nippon Kinzoku Gakkaishi, 28: 192-6(1964). (In Japanese)

The self-diffusion coefficients of nickel and copper in nickel–copper alloys containing 0 to 100% Cu were measured with a usual lathe sectioning technique. Polycrystalline specimens having 1 to 4 mm grain size were used. Measurements were carried out at the high temperature range near the melting point of each alloy. In this alloy system, copper atom diffuses more rapidly than nickel atom, and for each composition the ratio of diffusion coefficient of copper to that of nickel is from 2.5 to 6 over the temperature range examined. Diffusion rates of both elements increase with increasing copper contents. The frequency factors for nickel self diffusion were determined to be 1.9, 35, 17, 0.063, and 1.7 cm^2/sec, and the activation energies are 68.0, 74.9, 66.8, 49.7, and 55.3 kcal/mole in alloys containing 0, 13.0, 45.4, 78.5, and 100 at. % copper, respectively. For copper self diffusion in respective alloys, the frequency factors are 0.57, 1.5, 2.3, 1.9, and 0.33 cm^2/sec, and the activation energies are 61.7, 63.0, 60.3, 55.3, and 48.2 kcal/mole. (auth)

36025 ON THE RELATION BETWEEN HIGH-TEMPERATURE CREEP AND DIFFUSION IN NICKEL-BASE SOLID SOLUTIONS. III. DIFFUSION OF Ni^{63} AND W^{185} IN NICKEL–TUNGSTEN ALLOYS. Kaizo Monma, Hajime Suto, and Hiroshi Oikawa (Tohoku Univ., Sendai). Nippon Kinzoku Gakkaishi, 28: 197-200(1964). (In Japanese)

The self-diffusion coefficients of nickel and tungsten in nickel–tungsten alloys containing 0 to 9 at. % W were measured with a usual lathe sectioning technique. Polycrystalline specimens having 1 to 4 mm grain size were used. Measurements were carried out over the temperature range from about 1100 to 1400°C. In this sytem, nickel atom diffuses more rapidly than tungsten atom, and the ratio of diffusion coefficient of nickel to that of tungsten is from 3 to 4 for each composition over the temperature range examined. Diffusion rates of both elements decrease with increasing tungsten contents. The frequency factors for nickel self-diffusion are 1.9, 30, 58, and 1.1

cm^2/sec, and the activation energies are 68.0, 76.5, 80.6, and 70.3 kcal/mole for alloys containing 0, 1.7, 5.3, and 9.2 at. % tungsten, respectively. For tungsten self-diffusion in respective alloys, the frequency factors obtained are 2.0, 2.2, 17, and 1.4 cm^2/sec, and the activation energies are 71.5, 73.1, 80.5, and 74.5 kcal/mole. (auth)

36026 EFFECT OF ANNEALING ON PROPERTIES OF SINTERED WC–Co ALLOYS. Hisashi Suzuki, Masataka Sugiyama, and Takateru Umeda (Tokyo Univ.). Nippon Kinzoku Gakkaishi, 28: 287-91(1964). (In Japanese)

Alloys of WC–Co having 5 ~ 25% Co and various carbon contents were vacuum-sintered and subsequently vacuum-annealed at 600 ~ 800°C for about up to 50 hr. Some properties of the sintered alloys affected by the annealing were studied noticing their carbon content. After annealing, the hardness of alloys did not change; the rupture-strength decreased in association with the slight increase of hardness of binder phase; the lattice constant of the binder, and specific resistivity of the alloys decreased; the microstructure of the binder and its stability for acidic solutions changed. The changes in properties resulted from the precipitation of W atoms from the binder phase during annealing. This is believed to cause the properties of the alloys with a lower carbon content, viz, a higher dissolved W in the binder phase, to change remarkably. (auth)

36027 DEFORMATION STRUCTURES IN ZONE-MELTED MOLYBDENUM. A. Lawley and H. L. Gaigher (Franklin Inst., Philadelphia). Phil. Mag. (8), 10: 15-33 (July 1964).

Glide dislocation configurations in zone-melted single crystals of molybdenum, deformed in tension at temperatures from 4.2 to 300°K, were examined by thin film electron transmission microscopy. A majority of the crystals were oriented for single slip on the (011) [11$\bar{1}$] system, and were sliced and thinned parallel to (011). The slip band structure is characterized by long primary screw dislocations having a Burgers vector $a/2[11\bar{1}]$, and by secondary glide dislocations parallel to [111] or [$\bar{1}$11]. Consistent with the presence of secondary slip, the bulk stress-strain curves do not exhibit a region of easy glide. The primary screws have a high jog density ($\sim 5 \times 10^4$ cm^{-1}) which can be accounted for by the cutting of secondary dislocations intersecting the (011) glide plane. The jogs lower the velocity of the screw components relative to that of the edges, and from dislocation mobility data the calculated velocity ratio of edge : screw is ≈40 : 1, this appears to be a realistic ratio in terms of the lengths of screw and edge components seen in the micrographs. At low temperatures (≲200°K) the screw dislocations are straight and uniformly distributed on the slip plane. Glide configurations at 300°K are, in general, similar to those at the lower temperatures except that the screw dislocations are wavy, the distribution is less uniform and, surprisingly, the number of secondary slip dislocations is lower. Dislocation tangling is restricted to the immediate vicinity of inclusions or grown-in dislocations. The observations are consistent with a picture of yielding in which the true elastic limit is largely independent of temperature and corresponds to the movement of edge segments. The large temperature dependence commonly associated with the macroscopic yield point is, in reality, a flow stress measured in a region of extremely high work-hardening. It is suggested that movement of the screw dislocations is controlled by a thermally activated conservative movement of jogs. (auth)

36028 DIRECT CALCULATION OF ELECTRONIC PROPERTIES OF METALS FROM NEUTRON SCATTERING DATA. Gordon Baym (Univ. of Illinois, Urbana). Phys. Rev., 135: A1691-2(Sept. 14, 1964).

The cross section for the scattering of conduction electrons in a metal by the lattice oscillations is written in terms of the observed slow-neutron inelastic-scattering cross section. This enables one to include all multi-phonon processes, Debye-Waller factors, and umklapp processes in the electron-lattice interaction without having to use a phonon description of the lattice oscillations. Expressions which involve only the effective electron-lattice matrix elements and the observed neutron-scattering data are given for the electron self energy, phonon-induced effective mass, electric and thermal conductivities, and viscosity. (auth)

36029 THERMAL DIFFUSIVITY OF TANTALUM, MOLYBDENUM, AND NIOBIUM AT TEMPERATURES ABOVE 1800K. O. A. Kraev and A. A. Stelmakh. Teplofiz. Vysokikh Temp., 2: 302(1964).

The thermal diffusivity of tantalum, molybdenum, and niobium at temperatures ranging from 1900 to 3150, 1900 to 2500, and 1800 to 2600°K, respectively, was determined by the method of temperature waves. Disk-shaped specimens 8–9 mm in diameter and 0.2 mm thick in the case of tantalum and 0.3 mm thick in the case of molybdenum and niobium were used. The frequency of temperature oscillation was 290 and 530 cps for tantalum and 130 and 230 cps for molybdenum and niobium. The values of thermal diffusivity determined in $m^2/sec \cdot 10^{-4}$ are tabulated. (ATD Press)

36030 A STUDY OF ETCH-FIGURES OF DISLOCATION LINES IN MOLYBDENUM CRYSTALS. Duan Fong, Nay-ben Ming, and Chi Li (Nanking Univ., China). Wu Li Hsueh Pao, 20: 337-51(Apr. 1964). (In Chinese)

Experimental results concerning dislocation etch-pits on {100}, {111}, and {110} surfaces of electron beam floating zone-melted molybdenum single crystals are described. Electrolytic etching reagents used were mixtures of methyl alcohol, sulfuric acid, and chloric acid. Etch-lines arranged in parallel sets and hexagonal networks were also observed on {111} and {110} surfaces, these are interpreted as etch-figures of dislocation lines. An empirical rule for the interpretation of etch-figures of dislocation lines was deduced from observations. By means of multiple etching technique, some examples of dislocation arrangements in space are presented. Correspondence between etch-pits and sites of dislocation lines intersecting original surface was studied. In general, such correspondence was observed by means of an etching-polishing-re-etching technique. However, the results showed that such correspondence may be violated in some cases. For instance, when the angle between a dislocation line and observation plane is less than a critical value (15–24°), no etch-pit was observed. On the other hand, nodes of dislocation networks after prolonged etching, may be revealed as arrays of etch-pits. The significances of these results on the interpretation of etch-pits figures are discussed. The etch-figure method was compared with other methods of direct observation of dislocation lines, its merits and demerits are discussed, and it was concluded that the etch-figure methods are superior to all other existing methods in the study of dislocations in metal crystals when the dislocation density is within the range from 10^4 to 10^8 cm^{-2}. (P.C.H.)

36031 FIELD-MICROSCOPIC INVESTIGATIONS OF TUNGSTEN–MOLYBDENUM MIXED-CRYSTAL SYSTEMS. E. K. Caspary and E. Krautz (OSRAM-Studiengesellschaft, Augsburg, Ger.). Z. Naturforsch., 19a: 591-5(May 1964). (In German)

Single crystals of the W–Mo mixed crystal system could be highly resolved in a field microscope with helium ions at 20°K. An increased disintegration of the crystal surface was observed with increasing Mo concentrations (25, 50, and 75 at. %). In addition to the lattice defects arising during preparation, vacancies were observed. They were formed especially in the atomic decomposition of the crystal surface through field effects and could be traced back to the preferred field evaporation of the Mo from the mixed crystal. (tr-auth)

36032 STUDIES IN DIFFUSION THEORY, FERROMAGNETIC NUCLEAR RESONANCE IN Co^{59}, AND STACKING FAULT THEORY. Louis Edmund Toth. Thesis, Berkeley, Calif., Univ. of California, 1963. 106p.

A modification of Le Claire's microscopic model for self-diffusion is developed in a form applicable to diffusion in concentrated alloys. The relation of thermodynamic parameters to physical models is clarified. The calculated results for alloy diffusion usually agree with the experimental values to within the experimental error. The temperature dependence of the nuclear resonance spectrum of pure cobalt from 300°K to 900°K was re-examined with the aid of more sensitive apparatus. Cobalt alloyed with small concentrations of V, Cr, and Mn was studied by ferromagnetic nuclear resonance and saturation magnetization techniques in order to determine the extent of the disturbance of the hyperfine field around these impurities. The saturation magnetizations of the alloys Co–V, Co–Cr, and Co–Cr, and Co–Mn decrease at the ratio of 3.5, 4.2, and 3.5 percent for each percent of V, Cr, or Mn, respectively. In addition to the main fcc resonance at 213.1 Mc, a number of satellite resonances at frequencies only slightly separated from 213.1 Mc are observed for each alloy. The ferromagnetic nuclear resonances in ^{59}Co that occur intermediate in frequency between the resonance frequencies for the hexagonal and fcc phases are identified as coming from nuclei in stacking faults and twins. A method, based on effective c/a ratios of close-packed planes within the faults, is described whereby the resonance frequencies from nuclei in nonequivalent close-packed planes within a stacking fault can be calculated. The calculated frequencies are in good agreement with experimental results. The equations governing the net migration of solute atoms about extended dislocations were solved with the aid of a computer. Favorable segregation regions within the plane of the stacking fault are suggested. Phonon scattering from stacking faults in close-packed structure was calculated; the scattering depends upon local density gradients within the fault. The thermal conductivity in fcc structures is found to be isotropic provided the densities of stacking faults along each [111] direction are equal. (A.G.W.)

36033 THE DETERMINATION OF PREFERRED ORIENTATION IN ROLLED ELECTRICAL STEELS USING SINGLE DIFFRACTION OF NEUTRONS. Manuel Romulo Eugenio. Thesis, College Park, Md., Univ. of Maryland, 1963. 120p.

Preferred orientation in rolled electrical steels was determined using single diffraction of neutrons from the University of Maryland pool-type nuclear reactor (UMR) operating at 10 kw thermal. Neutrons were scattered directly from metallic sheet samples to obtain diffraction patterns from which preferred orientations of the crystallographic axes could be deduced. The neutron diffraction data were obtained in the form of Maxwellian curves and rocking curves. To obtain the first type of curve, the sample and neutron detector were rotated at a 1-to-2 angular ratio, respectively, and the diffraction pattern was essentially the Maxwellian neutron energy distribution. From the maximum of the Maxwellian curve, the crystallographic plane mainly responsible for the reflection was calculated; from this, the main orientation was deduced. For the second type of curve, the sample was rocked back and forth with the neutron detector fixed, and the resulting pattern was used to infer the variation of a given crystallographic direction about its main orientation. The results of this study, particularly on grain-oriented and cube-textured silicon–iron (Si–Fe) alloy sheets, demonstrate that single diffraction techniques can be used to determine preferred orientation in highly oriented materials. The results on Si–Fe sheets described as non-oriented indicate the possibility that these techniques may be applicable to ordinary rolled metallic sheets not highly oriented. (Dissertation Abstr., 24: No. 12, Pt. I (June 1964))

36034 THE TEMPERATURE EFFECTS OF MAGNETIC ORDER ON THE NEUTRON TOTAL CROSS SECTION. Ann Marie Dorothea Ripoli Kistner. Thesis, New York, Columbia Univ., 1963. 152p.

Studies were made of the neutron total cross sections of a series of compounds that have magnetic order-disorder transitions. The transmission measurements for the cross sections were made on the Columbia University neutron spectrometer, at the Brookhaven National Laboratory graphite reactor, over a range of neutron energies from 0.0006 to 2 ev. Cross sections are given, both as a function of sample temperature and of neutron wavelength, for MnO, MnS, terbium metal, and MnP, as a function of temperature for $Mn_{0.5}Zn_{0.5}Fe_2O_4$, Mn_2Sn, Fe_2O_3, and NaCl, and as a function of wavelength for MnF_2 and ZnF_2. The spectrometer, and sample syntheses and preparations are described. The temperature regulator and automatic sample changer built for these experiments are discussed in detail. The data presented show the effects of magnetic ordering on both the coherent and the inelastic incoherent cross sections. The variation of the inelastic cross section due to magnetic short range order in MnO is discussed. (A.G.W.)

36035 NUCLEAR MAGNETIC RESONANCE OF Pb^{207} AND In^{115} IN LEAD ALLOYS. Rex Jackson Snodgrass. Thesis, College Park, Md., Univ. of Maryland, 1963. 87p.

The nuclear magnetic resonance of ^{207}Pb was observed and accurately measured at room temperature and 77°K, in pure lead metal powder and in a series of lead alloy powders containing mercury, thallium, indium, and bismuth as solutes. The fractional change in the Knight shift of ^{207}Pb upon the addition of solute atoms is found to be small, $\Delta k/k \approx 1\%$ at 20% solute. The ^{207}Pb resonance frequency increases upon addition of Hg, Tl, and In, and decreases upon addition of Bi. The shifts are linear within experimental error and correlate, at least qualitatively, with valence. An estimate of volume effects, assuming a free electron model, indicates that the changes in volume associated with alloying may cause appreciable frequency shifts. From the temperature dependence of the pure lead linewidth, the spin-lattice relaxation time for lead metal is found to be $T_1 = 3.6 \times 10^{-4}$ sec at 77°K. The high-In concentration linewidths seem to be reduced at 300°K by motional narrowing. The Pb–In system is considered representative of all the alloys, and the observed linewidth is separated into its separate contributions. The nuclear resonance of ^{115}In in Pb–In alloys was observed and measured throughout the cubic lead phase at 77 and 300°K, in spite of the large electric quadrupole moment

of ^{115}In. The change in Knight shift of ^{115}In as a function of concentration between 10 and 35% In at 300°K is only $\Delta k/k = 2\%$. The change in ^{115}In shift in going from the tetragonal indium lattice to the cubic lead lattice is also small. These data are discussed in terms of the electronic structure of Pb and In atoms, and in terms of the other experimental results. (A.G.W.)

36036 TERNARY OXIDES OF 5 AND 6 VALENT Np AND Pu WITH Li AND Na. L. Koch. Thesis, Karlsruhe, Ger., Technische Hochschule, 1963. 69p. $2.00(Gmelin, AED-DISS. 63-477). (In German)

The system Me_2O-XO_2-O with Me = Li, Na and X = U, Np, and Pu is investigated. Lattice constants are given. Thermal stability under oxidizing conditions is studied. (Gmelin Inst.)

36037 HIGH PURITY YTTRIUM OXIDE FOR ELECTRONICS APPLICATIONS. John P. Dietrich and Laurence J. Silverstein (Research Chemicals, Phoenix, Ariz.). 3p. (CONF-553-6)

From American Ceramic Society 66th Annual Meeting Including Symposium on Nuclear and Space Applications, Chicago, Apr. 1964.

The purification of Y_2O_3 for electronics application is discussed. Rigid controls used in the process are given. The analysis of the material, after processing, was: Ca ~0.008%, Si ~0.008%, and Mg ~0.005%, with an average particle size of 1.1 μ. The final product was purified considerably and the particle size was reduced significantly. (P.C.H.)

Radiation Effects

Refer also to abstract 35805.

36038 (AD-433623) INVESTIGATION OF TRANSIENT RADIATION DAMAGE IN SEMICONDUCTOR MATERIALS. Third Quarterly Progress Report, August 1–October 31, 1963. Roland M. Lichtenstein (Rensselaer Polytechnic Inst., Troy, N. Y.). Contract DA 36-039 AMC-02165 (E). 21p.

A high-frequency technique was developed for the measurement of bulk carrier lifetime in silicon samples. The use of contacts was eliminated. The technique is based on the measurement of the Q-value of a tank of circuit, which contains the sample. A single tube (6J6) is used to generate the oscillations and to measure transient changes of the Q-value. (auth)

36039 (AFCRL-64-2) THEORETICAL CORRECTIONS FOR DETERMINING RESISTIVITY CHANGE OF METALS CAUSED BY ELECTRON BOMBARDMENT. Scientific Report No. 2. Charles H. Sherman (Parke Mathematical Labs., Inc., Carlisle, Mass.). Dec. 1963. Contract AF19(628)-2419. 37p. (AD-430985)

An observed change in the resistivity of a metal caused by electron bombardment can only be interpreted quantitatively after certain corrections have been applied to account for unavoidable experimental complications. Three of the major corrections which must be applied in such experiments are discussed, methods are developed for calculating their values, and graphs of numerical values are presented. The three corrections considered are: (1) the energy correction to account for the energy distribution of the bombarding electrons, (2) the scattering correction to account for the zig-zag path of the electrons through the sample, and (3) the surface correction to account for the influence of the sample surfaces on the measured resistivity. (auth)

36040 (AFOSR-J1553) RADIATION DETECTION BY DECORATION IN SILVER CHLORIDE CRYSTALS. Charles B. Childs and Lawrence M. Slifkin (North Carolina. Univ., Chapel Hill). [1963]. Contract AF49(638)-865. 29p. (AD-427405)

A review is given of the decoration of imperfections in silver halides with emphasis on volume decoration used in radiation detection. The selection, preparation, and decoration of silver chloride crystals are discussed with illustrations of decorated imperfections. Examples of primary cosmic ray particles and high energy proton collisions in silver chloride crystals are presented. The unique features of these crystals as radiation detectors are absence of humidity effects, absence of distortion, nonchemical development at room temperature, delineation of tracks in less than two hours, and crystal thicknesses greater than 3000 microns. (auth)

36041 (APL-TDR-64-20) WEBBED DENDRITIC SILICON SOLAR CELL RADIATION EFFECTS INVESTIGATION. R. V. Babcock and K. H. Sun (Westinghouse Electric Corp. Research Labs., Pittsburgh). Mar. 1964. Contract AF33(657)-10527. 105p. (AD-434706)

An investigation was conducted to determine the optimum structure for silicon solar cells, with regard to resistance to damage by 2 Mev electrons. The parameters considered were cell type, i.e., P/N or N/P, junction depth, and base resistivity. Of all the parameters affecting cell radiation resistance, the initial efficiency was found to have the largest effect. A comparison was made to assess the superiority of the optimum N/P structure, for 2 Mev electron flux densities in the range 10 to the 13th 10 to the 15th power electrons/cm^2. The degradation rate per decade of flux for the P/N structure was about 25 vs 21% for the N/P cells. (auth)

36042 (BMI-1679) FISSION-FRAGMENT-INDUCED DIMENSIONAL CHANGES IN PYROLYTIC CARBON. Thomas S. Elleman, Robert B. Price, and Duane N. Sunderman (Battelle Memorial Inst., Columbus, Ohio). July 23, 1964. Contract W-7405-eng-92. 17p.

To gain a better understanding of possible causes of coating failure of pyrolytic-carbon-coated fuel particles during irradiation, fission-fragment-induced dimensional changes were observed by: (1) lapping flat surfaces on coated fuel particles and measuring changes in the surface plane following irradiation, (2) measuring changes of the radius of curvature of unrestrained carbon tubes irradiated on the inner or outer surfaces with fission recoils, and (3) measuring the deflection of thin carbon disks after one face was irradiated with fission fragments. Fission-fragment-induced contractions were observed, but it was also possible to obtain behavior which appeared to indicate fission-fragment-induced expansion. (auth)

36043 (BNL-7214) EFFECT OF IRRADIATION TEMPERATURE AND ANNEALING TEMPERATURE ON EXPANSIONS AND CONTRACTIONS IN ALTERNATELY IRRADIATED AND ANNEALED GRAPHITE. Donald G. Schweitzer and Robert M. Singer (Brookhaven National Lab., Upton, N. Y.). [1963]. Contract [AT(30-2)-Gen-16]. 6p.

Graphite samples were annealed at 350°C after each of a series of different exposures at a fixed irradiation temperature, and the ratio of growth (G) over recovery (R) was measured. For the range of exposures studied, 0-300 Mwd, the ratio of expansion during the re-irradiation to the contraction occurring at 350°C was proportional to the exposure between the 350°C anneals and was independent of the temperature of irradiation. It was found that as the exposure between anneals increased, higher

annealing temperatures were necessary to retain dimensional stability. (P.C.H.)

36044 (CEND-3336-218) DEVELOPMENT AND TESTING OF A TEMPERATURE TRANSIENT METHOD FOR PERFORMING IN-PILE THERMAL CONDUCTANCE TESTING. Progress Report [for] Period Ending June 30, 1964. C. E. Burdg, J. R. Parrette, R. I. Brockett, and W. P. Chernock (Combustion Engineering, Inc. Nuclear Div., Windsor, Conn.). July 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(30-1)-3336. 29p. (EURAEC-1154)

A concept is investigated whereby the transient temperature response at the surface of an operating fuel element, following a reactor power change, will yield thermal conductance values. This two-phase investigation will consist first of out-of-pile demonstrations of feasibility, followed by in-pile confirmation of the method. Concurrent mathematical analysis of the thermal model will provide the basis for data interpretation, as well as guides for the design of the experimental portions of the program. Initial analytical models of both the out-of-pile and the in-pile cases are presented, and the methods of converting the continuous differential equations into usable finite difference equations are described. These have been used in preparing an analog computer simulation of the out-of-pile thermal model; the first runs made on the analog indicate agreement with observed physical phenomena. (auth)

36045 (EURAEC-1100) THE EFFECT OF RADIATION ON THE DUCTILE-BRITTLE TRANSITION IN PRESSURE VESSEL STEELS. Quarterly Report No. 14, April 1–June 30, 1964. E. Anderson, D. Brandon, D. King, M. Malone, and J. Spreadborough (Battelle Memorial Inst. International Div., Geneva). July 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract 095-62-12-RDS.

The data obtained by tensile tests on Armco iron and binary alloys of iron containing a few percent of manganese, chromium, and silicon are given are given and discussed. Results for the iron–manganese alloys are similar to those for Armco iron, although at low temperatures the lower yield stress, σ_y, is less temperature dependent. For average grain diameters, 2d, in the range of $d^{-\frac{1}{2}}$ from 9.5 to 13.2 $cm^{-\frac{1}{2}}$, the additions of 1.09 at.% manganese reduces the ductile-brittle transition temperature by approximately 15°C. Three iron–chromium alloys containing 1.11, 2.98, and 3.88 at.% chromium have been examined, and the behavior is similar to that of Armco iron. Chromium seems to have little effect on σ_y of Armco iron at temperatures down to –102°C; at –154°C and below chromium considerably reduces σ_y, possibly because of twinning. For a $d^{-\frac{1}{2}}$ of 9.5 $cm^{-\frac{1}{2}}$, a 1.11 at.% chromium alloy is more brittle than Armco iron; for finer grain sizes all the chromium alloys and Armco iron have approximately the same ductile-brittle transition temperatures. An iron–0.92 at.% silicon alloy is more ductile than Armco iron for $d^{-\frac{1}{2}}$ between 8 and 9.5 $cm^{-\frac{1}{2}}$. At room temperature and –54°C, σ_y, for constant $d^{-\frac{1}{2}}$, is increased by between 2.5 and 4 kg/mm^2 by the addition of the silicon; at –102°C, σ_y is approximately unchanged, while at lower temperatures silicon additions significantly lower σ_y. (auth)

36046 (GA-5495) EFFECT OF NEUTRON IRRADIATION ON MATERIALS SUBJECTED TO MULTIAXIAL STRESS DISTRIBUTIONS. Quarterly Progress Report, April 1–June 30, 1964. P. W. Flynn and T. A. Trozera (General Atomic Div. General Dynamics Corp., San Diego, Calif.). July 27, 1964. Contract AT(04-3)-167. 7p.

Neutron-irradiation effects on A302B steel tubes subjected to a postirradiation biaxial stress distribution are studied. The development of a deformation theory to correlate uniaxial tensile data with data from a multiaxial stress distribution is discussed. (T.F.H.)

36047 (HW-82102) EFFECTS OF NEUTRON IRRADIATION ON THE FLOW AND FRACTURE BEHAVIOR OF ZIRCALOY-2. A. L. Bement, J. C. Tobin, and R. G. Hoagland (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 1, 1964. Contract AT(45-1)-1350. 30p.

The effects of cold work and neutron irradiation on the deformation and fracture behavior of Zircaloy-2 were studied. Both annealed and cold-worked specimens were given fast neutron exposures over the range 10^{19} to 10^{21} n/sq cm at irradiation temperatures of 60 to 280°C. Specimens were taken both from the transverse and rolling directions of sheet containing 0, 10, 20, 40, and 70% cold work. The preferred orientations imparted by cold rolling were characterized by x-ray diffraction. (auth)

36048 (SWRI-1243-14) DEVELOPMENT OF NONDESTRUCTIVE TESTING INSTRUMENTATION FOR REACTOR PRESSURE VESSELS. Sixth Quarterly Report, April 1–July 10, 1964. John R. Barton and Robert D. Wylie (Southwest Research Inst., San Antonio). July 10, 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(11-1)-1243. 179p. (EURAEC-1170)

The development of techniques and instrumentation for non-destructively determining the effects of radiation on the nil-ductility transition temperature of reactor pressure vessel steels is reported. The steels studied are A212B and A302B. Effects of cold working are taken into account. (T.F.H.)

36049 (TID-20931) EXPLORATION OF THE EFFECTS OF SOME PROCESS VARIABLES ON THE RADIATION-INDUCED CONTRACTION OF GRAPHITE. Final Report, March 1, 1963–July 1, 1963. R. W. Marek and W. E. Parker (Speer Carbon Co. Research Lab., Niagara Falls, N. Y.). Contract AT(45-1)-1350. For General Electric Co. Hanford Atomic Products Operation, Richland, Wash. 31p. (SCC-19)

Seven sets of graphite samples were prepared to explore the effects of volume change during thermal processing. The "Green to Graphite" volume change was systematically varied from –5.6% to +4.9%. This change was directly related to the graphitization rate while raw materials and all other processing conditions were held constant. Final top graphitization temperature was identical for all sample sets in this series. Seven sets of rods were also prepared with a graphitized filler. These rods were processed to a series of top temperatures so that the effect of binder graphitization on the changes induced by neutron radiation could be investigated. A demonstration of the temperature dependence of thermal purification was obtained. To provide a sample set for determination of the effect of processing contraction on neutron radiation contraction, use was made of a green pitch coke and an Fe_2O_3 additive formulation, in conjunction with optimized fabrication procedures, to produce a material having a maximum shrinkage of –35.0% during processing from "Green to Graphite." (auth)

36050 (EURAEC-1006) RARE GAS DIFFUSION IN SOLIDS. Final Report No. 3, September 1, 1962–December 12, 1963. A. Brenner, F. Felix, T. Lagerwall, H. Migge, A. Richter, P. Schmeling, and K. E. Zimen (Hahn-Meitner-Institut für Kernforschung, Berlin). Mar. 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract 094-62-9-RDD. 36p. (Translation of EU-B-29)

Mathematical methods for the evaluation of ideal post-activation-diffusion are mentioned and possible causes for non-ideal release are discussed. Experimental results cover some apparative improvements and new results on the systems UO_2/Xe, UC/Xe, ThO_2/Xe, CaF_2/Ar, KCl/Ar, and AgLi/He, with special regard to single crystals. Activation energies for the Xe-133 diffusion have been determined in UO_2 single-crystals (70 kcal/mole between 1050 and 1760°C); UO_2 sintered material (53 kcal/mole between 800 and 1400°C); and ThO_2 crystals (81 kcal/mole between 1200 and 2000°C). The gas release from UC single crystals showed unexplainable deviations. The diffusion mechanism of Ar in CaF_2 single crystals has been revealed. In the intrinsic range (600 to 1300°C), an interstitial mechanism is present with an activation energy of 67 kcal/mole. In the extrinsic range it could be shown that no lattice diffusion, but probably a gas transport over vacancies with an activation energy of 8 kcal/mole, is predominating. The influence of the irradiation dose on the system CaF_2/Ar gives, for high doses, too low a diffusion coefficient, which is not representative of the diffusion process. (auth)

36051 LOW-TEMPERATURE NEUTRON IRRADIATION DAMAGE IN ALUMINUM AND GOLD. M. L. Swanson and G. R. Piercy (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Phys., 42: 1605-23(Aug. 1964).

Fast neutron irradiation damage at 1.74°K and its recovery to 100°K were investigated in Al and Au by means of residual electrical resistivity measurements. The effects of impurities, quenched-in vacancies, and dislocations were studied. It was found that the damage rate of Al was unchanged by impurity concentrations of less than 0.5 at.% and quenched-in vacancy concentrations of less than 0.002 at.%. Dislocation concentrations of $\sim 2 \times 10^{10}$/cm^2 in Al and $\sim 10^{11}$/cm^2 in Au increased their damage rates by 35% and 50% respectively. Small amounts of impurity (~0.02 at.%) in Au increased its damage rate by 15% and suppressed the enhancement caused by deformation. The stage I recovery of Al and Au was only slightly increased by extra dislocations, but was increased considerably by quenched-in vacancies. An impurity concentration of ~0.5 at.% suppressed the stage I recovery of Al, but not that of Au. The results are interpreted in terms of channeling in Al and collision chains in Au. (auth)

36052 RADIATION EFFECTS ON MATERIALS. Robert Gill and Ralph White (ITT Cannon Electric Inc., Los Angeles, Calif.). Cannonade, 16: 2-3(Jan.-Feb. 1964).

It is stressed that the only safe approach to developing radiation resistance is through the field of nuclear physics, since the solution lies in what transpires in a material under radiation bombardment and the disruption of the atom. Fiberglass reinforced Teflon was found to retain some of its flexibility as well as 40 per cent of its tensile strength at radiation exposure of 7.9×10^{15} n/cm^{-2} and 1.2×10^{-10} ergs 8^{-1} (C). (auth)

36053 RADIOLYSIS OF HYDROCARBONS ON A SEMICONDUCTING ADSORBENT. I. A. Myasnikov. Dokl. Akad. Nauk SSSR, 155: 1407-10(Apr. 21, 1964). (In Russian)

It is suggested that the accumulation of such particles as atoms, radicals, or ions on the surface of an adsorbent may be one of the chief causes of the irradiation effect on the rate and direction of radiochemical heterogeneous processes. Experiments were made to identify some of these particles and to study their reaction with adsorbed molecules and adsorbents. The semiconductor used was a thin ZnO film on a quartz backing. When the irradiation took place in the presence of butane or isobutylene, the increase in electroconductivity was significantly greater than in the presence of neon or in a vacuum. Increasing the butane pressure increased the radiolysis effect proportionally. In liquid butane the gamma effect increased significantly. Increasing the temperature at first increased the effect, which went through a maximum and then decreased. Discontinuation of the irradiation resulted in the reverse effect, and the higher the temperature the more rapid was the reverse effect. The effects observed are considered to be related to chemisorption of butane and isobutylene and formation of positive ions on the surface of the adsorbent and to chemisorption of hydrogen atoms formed in the radiolysis. The subject is developed mathematically. (TTT)

36054 TRANSIENT RADIATION EFFECTS ON ELECTRONIC COMPONENTS. A DESIGN GUIDE. Irving Doshay (Space General Corp., El Monte, Calif.). Elec. Design News, 9: 92-101(Mar. 1964).

Information is given which can be used to make initial component selections that will optimize resistance to transient radiation effects. Circuit reliability can be improved further by providing within the circuit sufficient latitude for changes in component characteristics. Changes in circuit characteristics may be established through interpretation of the changes that are expected to occur in the components. It is recommended, however, that a program of sequential tests, with operation in various levels of radiation fluxes, be performed for the selected components to better establish the effectiveness of mitigating radiation degradation in a system analysis. (auth)

36055 FIELD EFFECT TRANSISTORS UNDER NUCLEAR RADIATION. Alvin B. Kaufman (Litton Industries, Woodland Hills, Calif.). Electron Ind., 23: 94-7(Mar. 1964).

Field effect transistors, like other semiconductors, are affected by nuclear radiation. However, some of the changes are not the same as for conventional transistors; in fact, they are exactly the opposite. The exposure, to which the devices were subjected, was found by Litton using their microfoil techniques. The total gamma-ray exposure, measured in ergs/gm, was 2.7×10^{10}. The FET performance is reported versus an epithermal neutron exposure, i.e., all neutrons/cm^2 with an energy above 0.48 ev. The irradiation was carried out at 55°C ambient temperature at the ground test reactor. The radiation exposure to degrade the average gm of the 8 specimens to 0.7 of the baseline value ($gm/gm_0 = 0.7$) was about 1×10^{14} epithermal neutron/cm^2. (auth)

36056 EFFECT OF IRRADIATION ON MAGNETIC PROPERTIES OF Fe–Ni ALLOYS. A. I. Schindler (Naval Research Lab., Washington, D. C.), R. H. Kernohan, and J. Weertman. J. Appl. Phys., 35: 2640-6(Sept. 1964).

Hysteresis loop measurements were made on several commercial Fe–Ni alloys during neutron irradiations at 90°K and at temperatures up to 175°C, in both zero and saturating magnetic fields. Isochronal annealing tests were also performed on the alloys after irradiation. The low-temperature irradiation results indicated that magnetic properties are affected not by the point defects them-

selves, but by their motion and eventual disposition. The radiation-induced changes appeared similar in many ways to those observed in these alloys upon magnetic annealing. Experiments on the alloys at temperatures from 70 to 175°C in a saturating magnetic field showed that the activation energy of the radiation-induced process was 0.3 ev. In all cases the radiation-induced changes were annealed out at temperatures below the usual ordering temperature for Ni_3Fe. This recovery process appeared to be dependent upon the state of the magnetization of the sample. (auth)

36057 ENERGY DEPENDENCE OF PROTON IRRADIATION DAMAGE IN SILICON. W. Rosenzweig, F. M. Smits, and W. L. Brown (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Appl. Phys., 35: 2707-11(Sept. 1964).

The energy dependence of the rate of lifetime degradation in p-type Si for proton energies from 1.35 to 130 Mev was measured by observing the degradation of the bulk minority carrier diffusion length in silicon solar cells. The lifetime degradation/proton decreases monotonically with increasing proton energy. Significant deviations of the energy dependence from predictions of a simple model were noted. (D.C.W.)

36058 MICROSTRAIN YIELD STRESS IN NEUTRON-IRRADIATED COPPER SINGLE CRYSTALS. T. J. Koppenaal (Argonne National Lab., Ill.). J. Appl. Phys., 35: 2750-3(Sept. 1964).

The stress τ_0 necessary to produce a plastic strain of 2×10^{-6} was measured in neutron-irradiated Cu single crystals as a function of neutron dose (~10^{16} to 10^{20} neutrons/cm^2) and testing temperature (77 and 300°K), τ_0 increases from about 0.3 kg/mm^2 for ~10^{16} neutrons/cm^2 to over 5 kg/mm^2 for ~10^{20} neutrons/cm^2; in annealed Cu crystals, τ_0 is ~0.02 kg/mm^2. At all neutron doses, τ_0 is about 75% of the macroscopic flow stress. τ_0 is observed to increase with the cube root of the neutron dose; the macroscopic flow stress shows the same dose dependence. The results are explained on the basis of dislocation generation and obstacle cutting mechanisms controlling the yielding. These mechanisms are thought to be simultaneously operative. (auth)

36059 ROOM-TEMPERATURE DIELECTRIC PROPERTIES OF FAST-NEUTRON-IRRADIATED FUSED SILICA AND α ALUMINA. J. B. MacChesney and G. E. Johnson (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Appl. Phys., 35: 2784-5(Sept. 1964).

The effects of fast neutrons on the dielectric constant and the dissipation factor of fused silica and polycrystalline alumina were measured at 1 Mcps. The accompanying changes in the density of the silica and the cell constants of the alumina were also determined. (D.C.W.)

36060 METHOD OF PRODUCING A PATTERN OF MULTI-COLORS IN A GLASS PLATE BY IRRADIATION. Hiroshi Sasakura, Nozomu Takeuchi, Masakazu Miyagi, Hiromi Matsuda, Hisao Kami, and Torao Nobusawa (Industrial Research Inst., Osaka Prefecture). Japan. J. Appl. Phys., 3: 160-1(Mar. 1964).

A new technique for putting a multicolored pattern on a Au-glass or Au–Mn glass sheet was described. The samples were irradiated by a 2.5 Mev electron beam at a dose rate of 1×10^7 rep/min. After the irradiation, the samples were heat-treated, which changed the color of the irradiated sample. (P.C.H.)

36061 OBSERVATION OF ELECTRON-IRRADIATION DAMAGES IN LiF SINGLE CRYSTAL BY ELECTRON MICROSCOPE. Kenzo Tanaka, Michihiko Mannami, Kunihide Izumi, and Osamu Akisue (Kyoto Univ.). Japan. J. Appl. Phys., 3: 164-5(Mar. 1964).

The observation of electron irradiation damages in LiF single crystals during electron microscopy is reported. Voids about 200 Å in dia grew larger by further electron irradiation to give typical pair loop images. In some micrographs, however, the voids gave complex images, which were called cross pair loops. In each case, two lattice planes, which were perpendicular to each other, were simultaneously in Bragg condition. It was concluded that lens shaped voids are produced by the electron irradiation and that they grow to be about 1000 Å in dia when irradiated by more than 5 coulombs/cm^2 of electrons. (P.C.H.)

36062 PROPERTIES AND APPLICATIONS OF RUBBER REGENERATED BY RADIATION. W. Zielinski (Research Inst. for Nuclear Chemistry, Warsaw). Magy. Kem. Lapja, 19: 300-2(June 1964).

The feasibility of regenerating worn-out automobile tire rubber by ionizing radiation was investigated. The samples were irradiated with a cobalt radiation source of 6000 C activity at an average intensity of approximately 110 R per second gamma rays. Samples were withdrawn at intervals and examined for breaking load and elongation at fracture. Abrasion-resistance tests were also undertaken periodically. All fibrous material, such as tire cord residues, were destroyed while none of the significant characteristics of the rubber were adversely affected when the duration of the irradiation did not exceed 90 minutes. By using less costly radiation sources, such as used fissionable elements from high-output reactors, the procedure may become economically feasible for plant-scale regeneration. (OTS)

36063 IRRADIATION TEST ON SWAGED UO_2 FUEL. II. FISSION GAS BEHAVIOR. Shuichiro Takahashi, Yoshinobu Seki, Tadashi Kubota, Yutaka Hondo, and Tadahide Nohara (Mitsubishi Atomic Power Industries, Inc., Omiya, Japan). Nippon Genshiryoku Gakkaishi, 6: 393-9(July 1964). (In Japanese)

Fission gas behaviors of cold swaged UO_2 fuel rod, hot swaged UO_2 fuel rod, and sintered UO_2 pellets, which were irradiated to 2,700 Mwd/t-UO_2 and 10-13 kw/ft in burn-up and heat generation rate respectively, are described. The estimated gas pressure in fuel rods were 4 to 7 atm, although a fairly large amount of H_2 gas was found in fuel rods besides fission product gases. The contribution from fission product was determined to be less than 1% of total gas pressure. The release rate of Kr and Xe were 0.7%, 0.4%, and 0.03% in the cold swaged fuel rod, hot swaged fuel rod, and sintered pellets, respectively. (auth)

36064 MAGNETOTHERMAL OSCILLATIONS IN BERYLLIUM. J. LePage, M. Garber, and F. J. Blatt (Michigan State Univ., East Lansing). Phys. Letters, 11: 102-3(July 15, 1964).

Magnetothermal oscillations were observed in beryllium at 0.9°K in fields up to 20 kgauss. The largest oscillations observed in beryllium were about three times as large as those previously observed in bismuth. The maximum amplitude of the oscillations was ~0.01°K. (C.E.S.)

36065 CHANGE IN THERMAL CONDUCTIVITY UPON LOW-TEMPERATURE ELECTRON IRRADIATION: GaAs. Frederick L. Vook (Sandia Lab., Albuquerque, N. Mex.). Phys. Rev., 135: A1742-9(Sept. 14, 1964).

Measurements of the change in thermal conductivity of high-purity single-crystal GaAs were made upon 2-Mev electron irradiation and annealing. Two GaAs samples were irradiated at maximum temperatures of 100 and 80°K.

A linear increase in the additive thermal resistivity near 50°K is observed upon bombardment. The results yield $1/K - 1/K_0 = (3.15 \pm 0.2) \times 10^{-19}$ cm-deg/w per 2-Mev electron/cm^2. The experimental ratio of the point-defect thermal resistivity to the induced lattice strain at 50°K is $(1/K - 1/K_0)/(3\Delta L/L) = (1.0 \pm 0.2) \times 10^4$ cm-deg/w. Using estimates for the introduced defect concentration (based upon the change in strain rate as a function of electron energy) together with the observed increase in thermal resistivity, one obtains $1/K - 1/K_0 = (94 \pm 10) \times 10^2 C$ cm-deg/w, where C is the fractional point-defect concentration. This value is intermediate between those predicted by the point-defect scattering theories of Klemens and Ziman. Isochronal anneals carried out above 50°K with all measurements made at 50°K demonstrate low-temperature annealing in GaAs. Annealing is observed to begin near 55°K and accelerate near 190°K. About 70% of the additive thermal resistivity stable at 50°K anneals below 325°K. Definite minima are observed in the temperature dependence of the thermal conductivity, suggesting localized-impurity-mode scattering. The annealing, however, takes place over too large a temperature range to be due to a single thermally activated process. The change in shape of the temperature dependence of the thermal conductivity upon annealing indicates that below 325°K the defects anneal as point defects. For anneal temperatures between 325 and 575°K the point defects no longer remain isolated, and clustering or precipitation is suggested. (auth)

36066 CHANGE IN THERMAL CONDUCTIVITY UPON LOW-TEMPERATURE ELECTRON IRRADIATION: InSb. Frederick L. Vook (Sandia Lab., Albuquerque, N. Mex.). Phys. Rev., 135: A1750-7(Sept. 14, 1964).

Measurements of the change in low-temperature thermal conductivity of high-purity single crystal InSb were made upon 2-Mev electron irradiation and annealing. For small defect concentrations, the additive thermal resistivity increases as the $^3/_4$ power of the time-integrated flux Φ rather than the first power as observed for GaAs. The defect thermal resistivity is not proportional to the absolute temperature as predicted by the strain and mass-difference scattering theories of Klemens and Ziman. Irradiation to 5×10^{17} e/cm^2 below 52°K gave $1/K - 1/K_0 = 2.7 \times 10^{-13} \Phi^{3/4}$ cm-deg/w at 18°K. A similar result was obtained for measurements at 50°K. Isochronal anneals with measurements of thermal and electric conductivity made near 18 and 50°K indicated almost complete recovery of the thermal conductivity by 395°K. The increase in thermal resistivity on bombardment at 50°K is orders of magnitude larger for InSb than for GaAs even though InSb and GaAs exhibit the same increase in lattice strain per 2-Mev e/cm^2 at 50°K. It would be expected that GaAs would be more sensitive to point defects than InSb since GaAs is less limited by umklapp scattering at 50°K. The strain and mass-difference scattering theories of Klemens and Ziman can not explain the InSb data. The Keyes electron-phonon scattering theory based upon the large effect of strain on the defect electronic wave functions gives a plausible explanation. Annealing begins as low as 40°K for n-type InSb converted to p type on bombardment, whereas it was reported that no annealing occurs below 80°K in unconverted n-type InSb. Reverse anneals occur in both thermal and electric conductivity, implying the existence of at least two competing annealing processes. The activation energy for the anneal of thermal conductivity between 85 and 105°K agrees with that for the annealing of carrier concentration in p-type InSb, suggesting that the defects measured by electric and thermal conductivity are the same. (auth)

36067 THE FORMATION OF F CENTERS IN NaCl AND KCl CRYSTALS BY X-IRRADIATION. F. Froehlich. Thesis, Halle-Wittenberg, Ger., Universitlt, 1963. 96p. $2.00(Gmelin, AED-DISS. 63-368). (In German)

Time dependence of F center formation of x rays in thin NaCl and KCl crystals is studied. The increase immediately after irradiation is very sharp. Later, a linear increase was observed. A theoretical model with 2 differential equations is given. The dependence of the parameters of these equations on various factors such as purity and content of Ca ions is discussed. The design of an apparatus for the production of crystals is described. (Gmelin Inst.)

36068 DEPENDENCE OF IRRADIATION DAMAGE IN GERMANIUM ON INTENSITY OF IRRADIATION. James McDougall Kortright. Thesis, Lafayette, Ind., Purdue Univ., 1963. 77p.

N-type germanium monocrystals were irradiated at temperatures of 80°K and above with intense pulses of electrons of energy in the range from 0.5 to 1.4 Mev. The electron source is a microwave linear accelerator having a pulse length of one microsecond, at 120 pulses per second, and delivering ~10^{10} electrons per cm^2 per pulse. The resulting displacement of germanium lattice atoms produces localized defects that trap free electrons, as determined by the measurements of Hall effect. The rate of change of the carrier concentration n with the integrated electron flux ϕ is taken to be a measure of the cross section for the production of lattice defects. The carrier removal rate, $-dn/d\phi$, is found to depend on the irradiation rate (beam intensity). The intensity dependence of the cross section for defect production implies that more than one incident electron is operative in the production of a single defect. It suggests a multi-step process and some indirect mechanism, such as might be provided by energetic carriers or phonons, to assist in the formation of a stable defect. The results are qualitatively explained on the basis of a model of defect production proposed by MacKay and Klontz to explain their observations of the annealing of germanium irradiated at 10°K. Quantitative conclusions from the data are limited by variations in such experimental parameters as the incident electron pulse shape and the excess carrier recombination rate at the surface of the germanium specimen. (A.G.W.)

METEOROLOGY

36069 (AD-434554) HF COMMUNICATION EFFECTS SIMULATION: INSTRUMENTATION AND OPERATION OF THE FIELD EXPERIMENT. Interim Report 3. R. A. Shepherd (Stanford Research Inst., Menlo Park, Calif.). Dec. 1963. Contract DA 36-039 SC-87197. 103p.

The field-test phase of the experiment consists of an examination of six propagation paths, some of which pass through the auroral zone and some of which are south of the zone. These six paths are examined with oblique-incidence ionosphere sounders that collect propagation data between 4 and 64 Mc. Two of the paths are also studied using a phase-stable c-w system for the measurement of phase and amplitude of propagated signals. The primary equipment used in the experiment, consisting of Granger Associates ionosphere sounders and of a phase-stable c-w system developed by SRI, is described. (auth)

36070 (RM-4134) THE KOMPANEETS MODEL FOR RADIO EMISSION FROM A NUCLEAR EXPLOSION. V. Gilinsky (RAND Corp., Santa Monica, Calif.). Aug. 1964. 23p.

The electromagnetic signal from a nuclear explosion is computed using the same method as presented by Kompaneets. It is shown that some of Kompaneets' approximations are incorrect and lead to the wrong shape for the radiated signal. His work neglects the important first half-cycle of the signal and hence predicts an initial deflection in the wrong direction. A more correct solution is presented. (auth)

36071 DEUTERIUM. POSSIBILITIES OF APPLICATION TO THE RESEARCH PROBLEMS CONCERNED WITH SNOW, ICE, AND GLACIERS OF ANTARCTICA. C. Lorius. CNFRA (Comite Natl. Francais Rech. Antarctiques), No. 8, 108p.(1963). (In French)

Observations and samplings made during two expeditions to Antarctica in 1959–60 and in 1961 formed the basis for the discussion of the applicability of deuterium to the research problems concerned with snow, ice, and glaciers. The isotopic separations occurring during the evaporation and condensation of water are the actual basis for its use. The deuterium cycle in nature, the natural isotopic fractionation in the water cycle, and the methods used for measurements of concentrations, sampling, and sample preservation are described. The deuterium concentration in snow precipitations in Antarctica was determined as a function of the seasonal variations of the thermal structure of the troposphere. A relation was found between the deuterium concentration and the structure of the troposphere and the cloud temperature. Seasonal dating was made of the ice layers, and the snow accumulation during a season was determined. The validity of the different methods used for the determination of the snow accumulation was tested. A relation between the mean annual temperatures at the ground and the isotopic concentrations was derived. The ice beds were characterized and differentiated using deuterium concentrations. Stable isotopes can be used in glaciology to determine the mass balance and its evolution and to study climatic variations. (J.S.R.)

36072 TECHNIQUES EMPLOYED AT THE U.S. NAVAL RESEARCH LABORATORY FOR EVALUATING AIR-BORNE RADIOACTIVITY. L. B. Lockhart, Jr., and R. L. Patterson, Jr. (Naval Research Lab., Washington, D. C.). p.279-89 of "The Natural Radiation Environment." Chicago, University of Chicago Press, 1964.

Techniques used in the analysis of rain water for ^{210}Pb and of air for ^{210}Pb, ^{212}Pb, and ^{214}Pb are described. The effectiveness of filters toward radioactive aerosols was studied. Some typical results are given. (D.L.C.)

36073 RADIOACTIVITY OF THE RADON-222 AND RADON-220 SERIES IN THE AIR AT GROUND LEVEL. Luther B. Lockhart, Jr. (Naval Research Lab., Washington, D. C.). p.331-44 of "The Natural Radiation Environment." Chicago, University of Chicago Press, 1964.

Beta radioactivity measurements of ^{222}Rn and ^{220}Rn daughters in the air were carried out at various sites over the world over the period 1950 to present. Some of the data are presented. The geographical factor, seasonal variations of ^{214}Pb and ^{212}Pb in air, and variations in ^{214}Pb/^{212}Pb activity ratio are discussed. It is concluded that the simultaneous study of ^{222}Rn and ^{212}Pb in air can give information on both long-term and short-term atmospheric processes. (D.L.C.)

36074 MEASUREMENT OF NATURALLY OCCURRING RADIONUCLIDES IN AIR. S. Gold, H. W. Barkhau, B. Shleien, and B. Kahn (Robert A. Taft Sanitary Engineering Center, Cincinnati). p.369-82 of "The Natural Radiation Environment." Chicago, University of Chicago Press, 1964.

Measurements are reported of naturally occurring radioactivity associated with air particulates in Cincinnati, Ohio. ^{222}Rn and ^{220}Rn were determined by means of alpha measurements on their daughters. The effects of season, meteorological variables, and diurnal changes on the concentrations were studied. The ^{7}Be and ^{210}Pb concentrations were also measured during a short period in the spring of 1961. (D.L.C.)

36075 GEOGRAPHICAL DISTRIBUTION OF LEAD-210 (RaD) IN THE GROUND-LEVEL AIR. R. L. Patterson, Jr. and L. B. Lockhart, Jr. (Naval Research Lab., Washington, D. C.). p.383-92 of "The Natural Radiation Environment." Chicago, University of Chicago Press, 1964.

Observations in 1960 to 1962 were made of the ^{210}Pb concentrations in air at American sites along the 80th meridian and at Mauna Loa, Hawaii. The effects of latitude, season, and rainfall were studied. The ^{210}Pb concentration at any site was found to be quite variable because of changing weather patterns and the location of the site relative to ^{222}Rn sources. Because of the predominance of deposition processes over ^{210}Pb generation in the higher southern latitudes, concentrations in the Antarctic region are extremely low. The ^{210}Pb in any air sample does not appear to be related to the ^{222}Rn in the same sample. (D.L.C.)

36076 PARTICULATE SAMPLING DEVICE. (to Litton Systems Inc.). British Patent 964,948. July 29, 1964. Priority date Dec. 29, 1961, United States.

A sampling device for collecting atmospheric debris is designed to work under isokinetic inlet conditions, i.e., without particle size discrimination in the inlet airstream. The device comprises an aerodynamically shaped probe with an inlet in one end and adapted to be attached to an airplane or other high-speed airborne vehicle. The probe has impactor means for collecting the debris and is surrounded by a tubular cowling for controlling the flow. (D.L.C.)

PHYSICS

General

Refer also to abstract 36751.

36077 (AD-602781) SMALL-ANGLE X-RAY SCATTERING: METHODS AND CONSIDERATIONS. Technical Report No. III. John A Williams, Bert Phillips (Tem-Pres Research, Inc., State College, Penna.); H. A. McKinstry, and G. E. Rindone (Pennsylvania State Univ., University Park). June 15, 1964. Contract NONR 4089(00). 40p.

The factors, which must be considered in small-angle x-ray scattering experimentation, are discussed. Various experimental considerations, such as collimation systems, monochromatization of the x-ray beam and detection of the scattered x rays are described, especially with reference to the Kratky collimation arrangement. The effects of parasitic scattering and sample thickness on the results in a scattering investigation are indicated. 46 references. (auth)

36078 (AFCRL-64-107) THE STUDY OF IONIC PROCESSES IN GASEOUS AFTERGLOWS. Final Technical Report. D. Smith, M. J. Copsey, and J. Sayers (Birmingham. Univ., England). Oct. 1963. 67p. (AD-434583)

Measurements of the decay of the densities of ion species in the afterglows following pulsed radio-frequency discharges in atmospheric gases were made to determine the reaction rates at thermal energies between various ions and neutral species. The following reactions were investigated: (1) The decay of the helium ion density in pure helium afterglows and the subsequent deduction of the ambipolar diffusion coefficient of the helium ion in helium gas molecules; (2) The charge exchange rates of the oxygen ion with oxygen and nitrogen molecules; (3) The charge exchange rates of the helium ion with oxygen and nitrogen molecules; and (4) The decay rate of the nitrogen ion in pure nitrogen gas preliminary to charge-exchange rate measurements between the nitrogen and cesium vapor. (auth)

36079 (RLE-TR-421) ELECTROMAGNETIC INDUCTION ON AN EXPANDING CONDUCTING SPHERE. Technical Report 421. Luiz C. Bahiana (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics). May 30, 1964. 74p. (AD-602435)

One of the explanations that has been proposed for the origin of the radio signals emitted by nuclear explosions in the atmosphere is that such signals are generated by the interaction of the hot, expanding, electrically conducting gases, which result from the explosion, with the earth's magnetic field. The model adopted for the study of this process consists of a conducting sphere expanding radially in a uniform, static magnetic field. The velocity is prescribed, as a function of space and time, for all points in the interior of the sphere. The problem consists in the determination of the electromagnetic fields and the electromagnetic force acting on the sphere as a result of its expansion. By prescribing the velocity, the hydrodynamic problem, which is difficult to solve, is avoided and the problem is restricted to the domain of classical electromagnetic theory. (auth)

36080 (RPI-328-8) LINEAR ACCELERATOR PROJECT. Annual Technical Report During FY 1964. Erwin R. Gaerttner (Rensselaer Polytechnic Inst., Troy, N. Y.). Contract AT(30-3)-328. 108p.

Studies are presented of neutron reactions with nuclei; neutron production in nuclear reactions; neutron scattering by nuclei and molecules; neutron diffusion, transport, thermalization, and spectra in various media; the use of a neutron time-of-flight spectrometer for neutron-scattering analyses; and operations and development of the Rensselaer Polytechnic Institute linac. (T.F.H.)

36081 (TID-7695(p.31-6)) PROPOSAL OF EXPERIMENTS ON ELECTROMAGNETIC RADIATION FROM A DISTANT NUCLEAR EXPLOSION. Wilson K. Talley and Edward Teller (California. Univ., Davis. Coll. of Engineering and California. Univ., Livermore. Coll. of Engineering).

A nuclear explosion is particularly suited to checking whether or not light velocity is independent of frequency. This question is of some interest when the radiation beam passes close to the sun. Such a check would put to the test a postulate of general relativity which has never been explicitly verified. This and other experiments could be made more interesting by emitting a greater fraction of the energy in the radar spectrum. A method of accomplishing such experiments is discussed. (auth)

36082 (FTD-TT-64-619) BIPOLAR FLOW IN A SPECIAL MAGNETIC FIELD. V. N. Danilov. Translated from Tr. Mosk. Fiz.-Tekhn. Inst., No. 10, 67-79(1962). 15p.

It is shown that in a magnetic field the effective space-charge compensation of an ion flow by electrons can occur, and that by selecting the appropriate magnetic fields, a high reciprocal compensation of the electron and ion space charges can be obtained. (auth)

36083 ON THE DECOUPLING PROCEDURE IN THE GREEN FUNCTION METHOD. Jan Szaniecki (Inst. of Physics, Poznan, Poland). Acta Phys. Polon., 25: 695-70 (May 1964).

The problem of decoupling Green's function in the case of low temperatures was investigated. It is shown that the decoupling procedure, as proposed by Tyablikov for a ferromagnetic with atom spin $S = \frac{1}{2}$ and subsequently generalized for the case of arbitrary spin, yields incorrect terms in $(T/T_c)^3$ and $(T/T_c)^4$. The two-time Green function was calculated exactly and, consequently, the correction of order $(T/T_c)^3$ was obtained. This proves to cancel out with the identical term in the series for the spontaneous magnetization of an isotropic cubic ferromagnetic. (auth)

36084 ANALYSIS OF MHD CHANNEL ENTRANCE FLOWS USING THE MOMENTUM INTEGRAL METHOD. W. Craig Moffatt (Massachusetts Inst. of Tech., Cambridge). AIAA (Am. Inst. Aeron. Astronaut.) J., 2: 1495-7(Aug. 1964.

Entrance flows were analyzed by the momentum integral method, assuming a Hartmann-like velocity distribution. The pressure distribution obtained is in remarkably good agreement with those obtained by more complex techniques. The effect of the boundary-layer velocity profile on the pressure distribution was investigated by repeating the calculations with a parabolic profile. (D.C.W.)

36085 INTERACTION OF AN OSCILLATING MAGNETIC FIELD WITH FLUID IN COUETTE FLOW. F. H. Shair (General Electric Co., Philadelphia). AIAA (Am. Inst. Aeron. Astronaut.) J., 2: 1510-11(Aug. 1964).

The problem of Couette flow interaction with an oscil-

lating transverse magnetic field was solved using a transformation that demonstrates the similarity between a set of transient MHD systems and a set of transient heat conduction systems. (auth)

36086 INTERACTION OF SPIN SYSTEMS THROUGH THE LATTICE. J. Henry (Universite Libre, Brussels). Bull. Classe Sci., Acad. Roy. Belg. (5), 49: 697-707(1963). (In French)

The evolution of n-systems of spins in interaction via the lattice is considered. Equations for the evolution of the n spin temperatures are established and solved. Generally speaking, the inverse of each spin temperatures varies in time as the sum of n exponentials. The relaxation times of these exponentials can be expressed in terms of transition probabilities corresponding to spin-spin interaction via the lattice. The case of two spin systems is considered in more detail. (auth)

36087 A REMARK ON THE ISOTOPE SHIFT IN NUCLEAR MAGNETIC SHIELDING. A. Saika (Kobe Univ., Japan) and H. Narumi. Can. J. Phys., 42: 1481-8(Aug. 1964).

Isotope shifts in nuclear magnetic shielding were calculated in the molecular hydrogen system by a semiempirical procedure, which assumes that the high-frequency term varies with internuclear distance R as R^m. It was found, through a comparison with other investigations, that the choice of $m = -1.9$ appears to be reasonable. If this choice is taken, then the isotope shift between HD and H_2 becomes $(0.04_7 \pm 0.02) \times 10^{-6}$, while the shielding constant for H_2 is $(26.5_1 \pm 0.3) \times 10^{-6}$. (auth)

36088 ELECTROMAGNETIC WAVES AND PHOTONS. Louis de Broglie. Compt. Rend., 258: 6345-7(June 29, 1964). (In French)

Beginning with the action of an electromagnetic wave on a receptor, it is shown how the coexistence of electromagnetic waves and photons in the Hertzian region and the optical region can be conceived. (tr-auth)

36089 MHD POWER. Richard Rosa and Arthur Kantrowitz. Intern. Sci. Technol., No. 33, 80-6: 89-90; 92 (Sept. 1964).

The operational principles of MHD generators are summarized, together with the status of chemically fueled generators and the potential of chemically fueled power plants. Nuclear MHD generation is briefly discussed, together with some generator design considerations including nonequilibrium ionization and generator temperature. (D.C.W.)

36090 CONTACT CHARGING OF MICRO-SIZED PARTICLES IN INTENSE ELECTRIC FIELDS. A. Y. H. Cho (Ion Physics Corp., Burlington, Mass.). J. Appl. Phys., 35: 2561-4(Sept. 1964).

Micron-sized particles (0.3 to 15 μ in radius) of metals such as aluminum, carbonyl nickel, molybdenum; semiconductors such as magnetite and zirconium hydride; and insulators such as aluminum oxide, silicon oxide, and ecospheres were charged by contact electrification in electric fields up to 8000 v in a 0.3-cm gap. The charges were measured with a drift-tube detector and a quadrupole mass spectrometer and compared with a theoretical value which includes the contact potential and the electric field. Experimentally, the contact charge is quite important for particles less than one micron in radius, but relatively unimportant for larger particles. The experimental values are in good agreement with the calculated values for the range of materials and particle sizes studied. (auth)

36091 PENETRATION OF KRYPTON IONS INTO MOLYBDENUM IN A GLOW DISCHARGE. C. Y. Bartholomew (Bell Telephone Labs., Inc., Allentown, Penna.) and A. R. LaPadula. J. Appl. Phys., 35: 2570-2(Sept. 1964).

Previous work indicated that the penetration depth of krypton ions into the molybdenum cathode of a glow discharge tube operated at 150 v was of the order of 10^4 Å after a 24-hr bombardment. Additional results indicate that this penetration depth increases with time of operation of the discharge. A diffusion-like process appears to be dominant in the initial period of bombardment, but later the removal of surface layers by sputtering becomes dominant. The penetration reaches a steady-state condition after a sufficient period of bombardment. (auth)

36092 MICROWAVE ABSORPTION AND DENSITY VARIATION IN MOVING STRIATIONS. S. F. Paik, J. N. Shapiro, and K. D. Gilbert (Raytheon Corp., Waltham, Mass.). J. Appl. Phys., 35: 2573-7(Sept. 1964).

The properties of a moving striation in the positive column of a d-c glow discharge are investigated using a pulsed microwave technique. The electron density and the power absorption in various portions of the striation are determined from the time-resolved resonant curves of a microwave cavity containing the discharge, and the variation of the electron temperature is inferred from the absorption measurement. The results show a large degree of variation of both the temperature and the density within one cycle of the striation. The variation of the light intensity measured with a photomultiplier tube is observed to be in phase with the temperature. These results are consistent with the Langmuir probe data and results of previous microwave measurements. (auth)

36093 EXCITATION OF CHARACTERISTIC X RAYS BY PROTONS, ELECTRONS, AND PRIMARY X RAYS. L. S. Birks, R. E. Seebold, A. P. Batt, and J. S. Grosso (Naval Research Lab., Washington, D. C.). J. Appl. Phys., 35: 2578-81(Sept. 1964).

Protons, electrons, and primary x rays were used to excite characteristic x radiation from individual specimens of Ti, Cr, Fe, Cu, Ge, Zr, and Au. The x-ray yield expressed as (photons/sr)/quantum increased with quantum energy in a similar manner for protons around 1 Mev and electrons around 50 kev. For primary x-ray excitation, the yield decreased with increasing quantum energy, a relation opposite to that for proton or electron excitation. It appears that the relative values of photoelectric absorption and scattering must be quite different for x rays and electrons to account for their opposite relation of yield vs energy. (auth)

36094 CORRELATION OF EMISSION PROCESSES FOR ADSORBED ALKALI FILMS ON METAL SURFACES. Ned S. Rasor (Thermo Electron Engineering Corp., Waltham, Mass.) and Charles Warner. J. Appl. Phys., 35: 2589-2600(Sept. 1964).

An analytical model is described in which the time-averaged charge of adsorbed particles is a function of the energy of transition between atomic and ionic states, as in a thermally ionized gas. The relation is used to determine the dipole moment of the adsorbed layer, including the effect of depolarization by adjacent charges. An expression is obtained which relates the emission properties to the temperature, degree of surface coverage, and basic properties of the substrate and adsorbate. Through estimation of the atom adsorption energy, a relation is obtained which gives a good correlation of

most available data for the emission properties of surfaces immersed in cesium vapor. (auth)

36095 DETERMINATION OF CAPTURE CROSS SECTIONS BY OPTICAL QUENCHING OF PHOTOCONDUCTIVITY. Richard H. Bube and Felix Cardon (Stanford Univ., Calif.). J. Appl. Phys., 35: 2712-19(Sept. 1964).

The electron capture cross section of sensitizing centers for photoconductivity was measured as a function of temperature between 77 and 350°K in CdS, Cd(SSe), CdSe, GaAs, and InP crystals. The value of the cross section is obtained from the measurement of the minimum number of quenching photons/sec required to initiate optical quenching at a temperature below that at which thermal quenching occurs. Forty-one determinations of cross-section on nine different crystalline samples yield values between 10^{-20} and 10^{-22} cm^2 with only slight temperature dependence. A consideration of the various models to account for such small capture cross sections without appreciable temperature dependence suggests that the cross section is associated with radiative capture by a neutral center. (auth)

36096 FISSION-FRAGMENT TRACKS AND DIRECTIONAL EFFECTS IN THE SURFACE OF LiF CRYSTALS. T. G. Knorr (Battelle Memorial Inst., Columbus, Ohio). J. Appl. Phys., 35: 2753-60(Sept. 1964).

Elongated damage structures resulting from fission fragments traveling nearly parallel to the surface were observed in (100) cleavage faces of bulk LiF crystals. These tracks have lengths up to 2.3 μ and are about 100 Å wide. The direction in which the fission fragment entered the LiF crystal can be determined from the characteristics of tracks which cross typical fracture steps in the crystal surface. When the fragment enters the surface, it registers a surface disturbance in the form of a trough defined by two ridges. Deeper in the crystal the fragment produces a single ridge and finally ceases to register a surface disturbance when it has penetrated more than about 30 Å into the crystal. Track length distributions were determined from a large number of tracks for two specimens. These show good agreement with a theoretical distribution based on straightforward geometrical considerations. Details of the theoretical development are outlined. There are, however, a disproportionately large number of tracks visible in ⟨100⟩ crystallographic directions. This would be explained if fragments registered surface disturbances from a greater depth in these particular directions. (auth)

36097 FIRST TOWNSEND IONIZATION COEFFICIENTS IN HYDROGEN AND DEUTERIUM. S. F. Barna, Jr., D. Edelson, and K. B. McAfee, Jr. (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Appl. Phys., 35: 2781-2(Sept. 1964).

Direct-current measurements of the ionization coefficient α in dueterium and hydrogen were made in a precision drift tube. The results are compared with previous determinations. (D.C.W.)

36098 WAVE-MECHANICAL APPROACH TO RELATIVISTIC THERMODYNAMICS. L. Gold (Kennecott Copper Corp., Lexington, Mass.). Nuovo Cimento (10), 33: 178-83(July 1, 1964).

The relativistic Maxwellian velocity distribution law is derived quantum mechanically, and Jüttner's earlier classical kinetic theory corroborated. The quantum formalism is found to lend itself most effectively for the rigorous development of relativistic thermodynamics while also permitting, for example, an accurate description of departure from the ideal gas law in the vicinity of absolute zero. (auth)

36099 IMAGE OVERLAP IN TRANSMISSION ELECTRON MICROSCOPY. J. H. Chute and J. G. Napier (Australian Atomic Energy Commission Research Establishment, Lucas Heights, Sydney). Phil. Mag. (8), 10: 173-6 (July 1964). (AAEC/TM-233)

A discrepancy exists between electron microscopy measurements of density of defect clusters in irradiated beryllium oxide and predictions from thermal conductivity and long wavelength neutron scattering experiments. A possible source of error is the overlapping of cluster images in the electron micrographs. An equation is derived, from a simple model, which allows an estimate to be made of the reliability of the observed density. (auth)

36100 TRIPLE COLLISION OPERATORS IN THE TRANSPORT THEORY OF DENSE GASES. K. Kawasaki and I. Oppenheim (Massachusetts Inst. of Tech., Cambridge). Phys. Letters, 11: 124-6(July 15, 1964).

The relation between the various forms of the triple collision operator in the transport theory of dense gases is discussed. (C.E.S.)

36101 ON THE THEORY OF He^4 IMPURITIES IN He^3. A. J. Leggett and D. Ter Haar (Oxford Univ.). Phys. Letters, 11: 129(July 15, 1964).

The behavior of ^4He impurities in ^3He is considered as the general problem of impurities in a Fermi liquid, and the temperature dependence of the relaxation times of an impurity due to fermions and of a fermion due to impurities is discussed. (C.E.S.)

36102 MEASUREMENT OF STARK PROFILES OF THE LYMAN-α AND LYMAN-β LINES OF HYDROGEN IN AN ELECTROMAGNETIC SHOCK TUBE. R. C. Elton (Naval Research Lab., Washington, D. C.) and H. R. Griem. Phys. Rev., 135: A1550-9(Sept. 14, 1964).

Measurements in the vacuum ultraviolet spectral region of optically thin (except in narrow wavelength bands in the line cores) profiles of the Stark-broadened Lyman-α and Lyman-β lines of hydrogen (0.03% admixture in 40 mm Hg helium) agreed to within 10% with Stark-broadening theory over three and two decades of intensity, respectively. A shot-to-shot scan technique was employed, using a highly reproducible T-type electromagnetic shock tube. The theoretical line-broadening calculations include both the effects of quasistatic ion microfields and those of electron impacts, whereas the Holtsmark theory neglects the electrons and differs by a factor of 2-3 on the far wings (depending upon the normalization). A peak temperature of 20,500°K (±8%) was determined spectroscopically from the helium line-to-continuum intensity ratio and was consistent with the hydrodynamic temperature obtained from shock-velocity measurements. A charged-particle density of a few times 10^{17} cm^{-3}, used in comparing the measured profiles with theory, was obtained from the visible continuum intensity and agreed with hydrodynamic predictions, as well as with half-width measurements of neutral helium lines in visible region. (auth)

36103 TIME-RELAXED PROBABILITY DENSITIES AND CORRELATION FUNCTIONS FOR MODERATELY DENSE FLUIDS. Ralph Nossal (Univ. of Michigan, Ann Arbor). Phys. Rev., 135: A1579-89(Sept. 14, 1964).

Kinetic equations are obtained for the purpose of describing the temporal evolution of two-time (conditional) probability densities for locating subsets of particles moving within an equilibrium assembly. The reduction and solution

of the equation for the single-particle density is investigated in considerable detail. Information concerning the short-time evolution of the probability densities is explicitly retained, in order that the applicability of the equations for studying the properties of relatively dense systems be preserved. The expressions for probability densities are used to study the properties of certain associated correlation functions. Expressions for the momentum autocorrelation function are derived. Similarly, certain features of the cross sections for the scattering of slow neutrons are investigated. (auth)

36104 REVERSIBILITY OF THE LIOUVILLE EQUATION AND THE APPROACH TO EQUILIBRIUM. Boris Leaf and William C. Schieve (Kansas State Univ., Manhattan and Naval Radiological Defense Lab., San Francisco). Physica, 30: 1389-1408(July 1964).

Two real solutions for the Liouville equation exist for a system whose number of degrees of freedom $N \to \infty$ and volume $V \to \infty$ with N/V finite. One solution is obtainable from the other by replacing τ, the time elapsed from the initial state by $-\tau$. Reversibility requires the existence of both solutions. One of the solutions converges as $\tau \to \infty$. This is the solution which describes the approach to equilibrium in the work of Prigogine's group. The other solution which diverges as $\tau \to \infty$ is not allowed physically, in accordance with a causality principle. The admission of only one of the two solutions introduces irreversibility. The convergence of the allowed solution as $\tau \to \infty$ results from the continuous character of the spectrum of the Liouville operator in the infinite limit, which gives rise to a Cauchy integral in the distribution function of the infinite system. The result that the distribution function for the entire infinite system converges as $\tau \to \infty$ is obtained without the use of perturbation theory. It is an extension of previous work by Prigogine's group demonstrating convergence of reduced distribution functions. The result does not require specific initial conditions or assumptions about the nature of the singularities of the Cauchy integral. The evolution of an infinite system is governed by a Hermitian transformation instead of a unitary transformation as for a finite system. In the infinite limit the Liouville operator becomes anti-Hermitian. Solutions of the adjoint Liouville equation and the inhomogeneous Liouville equation for infinite systems are also described. (auth)

36105 PHASE SEPARATION IN THE LIQUID MIXTURE OF NEON AND DEUTERIUM. J. P. Brouwer, L. J. F. Hermans, H. F. P. Knaap, and J. J. M. Beenakker (Kamerlingh Onnes Laboratorium, Leiden). Physica, 30: 1409-20(July 1964).

It was observed that a liquid mixture of Ne and D_2 separates into two phases. The phase separation curve was determined between the upper critical consolute temperature (25.9°K) and the temperature at which the phase separation curve intersects the freezing curve (23.8°K). The phase diagram was completed by measuring the freezing- and melting curves of the mixture. (auth)

36106 IONIZATION MECHANISM AND ELECTRON TEMPERATURE IN CESIUM ARCS. J. R. Fendley, Jr., and K. G. Hernqvist (RCA Labs, Princeton, N. J.). Proc. IEEE (Inst. Elec. Electron. Engrs.), 52: 964(Aug. 1964).

Electron temperatures of ≈ 3600°K were observed in a tube for conditions typical of thermionic diode operation. This value is in fair agreement with the prediction of a thermionic convertor theory in which direct ionization by electron impact with gas atoms in the ground state is assumed. For cesium diodes with a cathode temperature of ≈ 1500°K, the arc drop was concluded to be ≈ 0.4 v. (D.C.W.)

36107 THE ENERGY LOSS OF ELECTRONS IN SOLIDS. Andrew M. Rauth (Yale Univ., New Haven) and J. Arol Simpson. Radiation Res., 22: 643-61(Aug. 1964).

The total transmitted energy loss distribution of an initially monoenergetic electron beam was measured for thin films of varying atomic number. The films were thin enough (100 to 1500 A) and the incident electrons energetic enough (5 to 20 kev) so that the scattering distributions observed were representative of single and plural scattering. The distribution of energy losses above 100 ev for the organic films appeared consistent with a W^{-2} dependence, where W is the energy lost by the electron. From the experimental energy loss distributions measured, a value for the average energy loss per inelastic event, $\bar{K}$, for Formvar ($C_5H_8O_2$), polystyrene (C_8H_8), and carbon was found of approximately 60 ± 10 ev. For the other films investigated—Al_2O_3, aluminum, copper, gold, and silver—$\bar{K}$ was found to increase with the mean atomic number of the target material. (auth)

36108 GAS DISCHARGES AND THE ELECTRICITY SUPPLY INDUSTRY. Proceedings of the International Conference held at the Central Electricity Research Laboratories, Leatherhead, Surrey, England, 7th-11th May, 1962. J. S. Forrest, P. R. Howard, and D. J. Littler, eds. London, Butterworths, 1962. 688p.

Lightning investigations, electricity supply systems, corona, radio noise, breakdown of solid and gaseous dielectrics, plasma physics, and magnetohydrodynamics are discussed. Of the 56 papers presented, separate abstracts are prepared for the 13 papers on plasma physics and magnetohydrodynamics. (C.E.S.)

For abstracts of individual papers see: 36243, 36244, 36245, 36246, 36247, 36248, 36249, 36743, 36744, 36745, 36746, 36747, and 36748.

36109 RADIOACTIVE SOURCES. Guy Courtois and Pierre Le Clerc (to Commissariat à l'Énergie Atomique). U. S. Patent 3,145,181. Aug. 18, 1964. Priority date Mar. 17, 1960, France.

A radiation source is designed for use under high mechanical stresses in corrosive mediums and/or at high temperatures. The source comprises a radioactive substance (^{60}Co, ^{124}Sb, etc.) embedded in a pyroceram which in turn is enclosed in a stainless steel container in an envelope of sintered alumina. The pyroceram is a crystallized titanium glass free from potassium and sodium. The source can be used for measuring the wear of the refractory linings of blast furnaces, determining the thickness of a glass sheet leaving a furnace, etc. (D.L.C.)

Accelerators

36110 (BNL-8213) A PROGRAMME FOR RAY TRACING THROUGH A MAGNETIC LENS SYSTEM. J. Sandweiss, I. O. Skillicorn, and M. S. Webster (Brookhaven National Lab., Upton, N. Y.). Aug. 8, 1962. Contract [AT (30-2)-Gen-16]. 15p.

A ray tracing program for IBM 7090 is described for four types of regions: free space; quadrupole with 8, 12, or 20 pole aberrations; bending magnet with 6 and/or 10 pole aberrations; and zero-length sextupole. Subroutines are incorporated that permit rotation and displacement, and a focusing routine enables the calculation of beam parameters to obtain given ray configurations. (R.E.U.)

36111 (SLAC-28) A PULSED BENDING MAGNET FOR THE BEAM SWITCHYARD AREA OF THE STANFORD TWO-MILE LINEAR ELECTRON ACCELERATOR. H. Brechna (Stanford Univ., Calif. Stanford Linear Accelerator Center). May 1964. Contract AT(04-3)-400. 86p.

Results of detailed calculations and the derived design of a switching or pulsed magnet are presented. The magnet has a laminated H-type core and a multistranded water-cooled coil, and is suitable for bending an electron beam of 25 Bev/c to an angle of ±0.5°. The switching magnet is located in the beam switchyard area of the Stanford two-mile linear accelerator. Problems concerning the laminated core and the multistranded coil, the a-c losses, the temperature rise, and the effect of pole shaping on field homogeneity in the gap are treated. The design parameters of an inductive load to be used in connection with the pulsed magnet are given. The noise level and the core losses for the magnet are calculated. The design of the magnet for electrons of 25 Bev/c may seem conservative, but it was determined that the magnets should work also for electrons of 40 Bev/c, representing a later stage of the linear accelerator operation. (auth)

36112 (UCRL-11089) LONGITUDINAL RESISTIVE INSTABILITIES OF INTENSE COASTING BEAMS IN PARTICLE ACCELERATORS. V. Kelvin Neil and Andrew M. Sessler (California. Univ., Livermore. Lawrence Radiation Lab. and California. Univ., Berkeley. Lawrence Radiation Lab.). Oct. 23, 1963. Contract W-7405-eng-48. 35p.

The longitudinal electromagnetic interaction of an intense coasting beam with itself, including the effect of a resistive vacuum tank, is investigated theoretically. It is shown that even in the range where the particle frequency is an increasing function of particle energy, the beam can be longitudinally unstable due to the resistivity of the vacuum tank walls. In the absence of frequency spread in the unperturbed beam, the beam is shown to be always unstable against longitudinal bunching with a growth rate that depends upon $(N/\sigma)^{1/2}$, where N is the number of particles in the beam and σ is the conductivity of the surface material. By means of the Vlasov equation, a criterion for stability of the beam is obtained, and is shown in the limit of high-conductivity walls to involve the frequency spread in the unperturbed beam, the number of particles N, the beam energy, and geometrical properties of the accelerator, but not the conductivity σ. A numerical example is presented which indicates that certain observations of beam behavior in the MURA 40-Mev electron accelerator may be related to the phenomena investigated here. (auth)

36113 (UCRL-11090) TRANSVERSE RESISTIVE INSTABILITIES OF INTENSE COASTING BEAMS IN PARTICLE ACCELERATORS. L. Jackson Laslett, V. Kelvin Neil, and Andrew M. Sessler (California. Univ., Berkeley. Lawrence Radiation Lab.). Oct. 25, 1963. Contract W-7405-eng-48. 51p.

The transverse electromagnetic interaction of an intense azimuthally uniform beam of particles with itself, including the effect of a resistive vacuum tank, is investigated theoretically. It is shown that a beam of particles all having velocity v_0 is unstable against the development of transverse waves having a phase velocity close to $(1 - \nu/n)v_0$, where n is a positive integer and ν is the number of transverse free betatron oscillations occurring in one revolution. The growth rate for the instability is proportional to $N/\sigma^{1/2}$, where N is the number of particles in the beam and σ is the conductivity of the surface material of the vacuum tank. Stabilizing mechanisms are examined by means of the Vlasov equation and it is shown that a spread in phase velocity in the beam, namely a spread in the quantity $(n - \nu)v_0$ when evaluated for particles in the unperturbed beam, will prevent the instability. A criterion for the spread required is obtained, and in the limit of walls of high conductivity is shown to depend upon the beam intensity and energy as well as upon certain geometrical properties of the accelerator but, not upon the conductivity σ. Numerical examples covering a wide range of existing and contemplated particle accelerators are presented, and suggest that the theory is in agreement with the coherent beam behavior recently observed in a number of accelerators. (auth)

36114 (UJV-939/63) TELEMETRICKÉ ZAŘÍZENÍ PRO VAN DE GRAAFFUV URYCHLOVAČ 5 Mev UJV. (Telemetric Equipment for 5-Mev Van de Graff Accelerator). J. Schaeferling, and F. Srepl (Ceskoslovenská Akademie Ved. Ustav Jaderného Výzkumu, Rez). Aug. 1963. 15p.

Telemetering equipment designed for a 5-Mev pressure Van de Graaff accelerator is described. The equipment makes possible long-distance measuring of electric values in a high-voltage electrode of the accelerator by means of transmission by a light beam across a potential difference of 5 Mv. The measured values are indicated in the control-room with an accuracy of 1%. (auth)

36115 HIGH ENERGY ACCELERATORS. PART 5. Atomics, 17: No. 4, 25-36(July-Aug. 1964).

Accelerators with ratings higher than 1 Bev are discussed. All accelerators now operating or under construction are discussed with emphasis on the Argonne ZGS and the Stanford Linear Accelerator. Future accelerator development is also briefly considered. (C.E.S.)

36116 EFFECTS OF SPACE CHARGE ON TRANSVERSE WAVES IN ELECTRON BEAMS. J. E. Carroll (Services Electronic Research Labs., Baldock, Hertfordshire, Eng.). J. Electron. Control (1), 16: 633-51(June 1964).

Computer calculations and the resulting physical picture of space charge effects on cyclotron and synchronous waves are given. Criteria for the standard filamentary electron beam analysis to be valid are discussed. (auth)

36117 GENERAL PRINCIPLES OF DESIGN FOR A PRESSURIZED VAN DE GRAAFF GENERATOR. Sandor Szalay and Ede Koltay. Magy. Tud. Akad. At. Kut. Int. (Debrecen) Kozlemen, 6: 3-33(May 1964). (In Hungarian)

As the first step in the design of a Van de Graaff generator of 5 Mv rated voltage, studies of the relevant literature and model experiments were begun in order to establish the basic principles of generator design. To conform with the requirements of application, the objective was set to construct up-to-date equipment allowing continuous operation, and having low radiation background, moderate target current, and maximum energy stability. A critical study of the generator development achievements of the past few years led to the conclusion that the high-voltage insulation should be accomplished in a single air gap (omitting the intermediate electrodes). Under such conditions, regular maintenance work can be carried out with the generator in assembled state, the mechanical design will be much simpler, and advantage can be taken of a corona-triode voltage stabilization featuring low radiation background. Despite the conversion to large insulation gaps, the non-linear insulating strength of the insulating gas will not involve any difficulty. Measurements in an electrolyte tank have shown the distortion of potential distribution

at the point of transition from the cylindrical electrode to be greatly reduced by substituting a body of rotation termination (with varying curvature) of the high-voltage electrode for the traditional hemispherical termination. The acceleration tube of the generator is to be designed with an inclined field electrode arrangement. The error signals of the parallel slow voltage stabilizer circuits will be furnished by a reference-field generating voltmeter and by the outlet gap assembly of the analyzer magnet; the feedback will be accomplished by controlling in an electronic way the charging current and the load current through a corona triode. The generator is to be completed with a special ion-optical beam guide system. (auth)

36118 PERIPHERAL CEE BEAM EXTRACTOR FOR THE CHICAGO 460 Mev SYNCHROCYCLOTRON. E. H. Molthen (Univ. of Chicago). Nucl. Instr. Methods, 29: 29-34(Sept. 1964).

A peripheral beam extractor for the synchrocyclotron is described, which increases the duty factor of the external beam or the internal beam on target to 50%. The r-f drive puts a high voltage on the peripheral cee electrode with high standing wave ratio but low power loss over a sufficiently broad bandwidth to provide a flexible and efficient extraction of the circulating beam. (auth)

36119 RADIAL AND AZIMUTHAL DISTRIBUTIONS OF ELECTRONS OR POSITRONS IN STORAGE RINGS. H. Bruck (Ecole Normale Supérieure, Orsay, France). Nucl. Instr. Methods, 29: 54-60(Sept. 1964). (In French)

A theory of the radial and azimuthal distributions of electrons or positrons in storage rings is developed. The distributions result from the opposition between the perturbation effect of the quanta emissions and the damping of the oscillations. The distributions of the radial betatron displacements as well as of the particle energies are calculated. They are used to deduct the distributions of other entities pertaining to the radial betatron or synchrotron phase space. The particle density has a Gaussian distribution, radially and azimuthally. (auth)

36120 A LOW EVAPORATION TARGET FOR LIQUID HYDROGEN, DEUTERIUM OR HELIUM. V. Montelatici (CNEN, Frascati, Italy). Nucl. Instr. Methods, 29: 121-4 (Sept. 1964).

A liquid hydrogen, deuterium, or helium target, insulated by vacuum and low-temperature radiation shields, is described. For liquid hydrogen, the evaporation rate is $<10^{-2}$ l/hr. Deuterium is condensed by a single current heat exchange at a final pressure of about 0.4 atm, using nitrogen and hydrogen as refrigerating liquids. A valve system permits rapid emptying and filling of the liquid volume exposed to the gamma beam. Using liquid helium, the evaporation reaches values less than 2×10^{-1} l/hr. (auth)

36121 PARTICLE ACCELERATION BY CIRCULARLY POLARIZED ELECTROMAGNETIC WAVES. Winfried Otto Schuman (Technische Hochschule, Munich). Z. Angew. Phys., 17: 273-6(June 1964). (In German)

Particle acceleration by electromagnetic waves which propagate according to the law $\sin(\omega t - \beta x)$ was calculated. A stationary coördinate system and a coördinate system moving with phase velocity were considered. A relativistic evaluation of the final particle velocities was carried out. (tr-auth)

36122 LIMITATIONS ON CHARGE TRANSPORT THROUGH THE MAIN FIELD IN AN ELECTROSTATIC GENERATOR. Eduards Bailitis (Zentralinstitut für Wissenschaftliches, KFA, Julich, Ger.). Z. Angew. Phys., 17: 301-4(June 1964). (In German)

The operating point of an electrostatic generator is determined by the principal field strength and the transport field strength. It is shown that a dielectric-free region is possible only when the operating point is in the electrostatic stable range and that with increasing voltage the maximum value of the charge density admitted for the charge transport decreases. The current decrease observed generally in an increasing voltage can therefore be explained. (tr-auth)

36123 THE PRODUCTION OF HIGH CURRENTS OF RELATIVISTIC ELECTRONS IN CIRCULAR ACCELERATORS. H. Eicker. Thesis, Aachen, Technische Hochschule, 1963. 68p. $2.00(Gmelin, AED-DISS. 63-429). (In German)

A plasma betatron and an accelerator with helical field for the production of relativistic electrons are described. Dependence of maximum electron energy and bremsstrahlung intensity on stabilization and acceleration fields is studied. Maximum energy of the plasma betatron is 800 kev with a current of 0.4 amp. Corresponding values for the helical field accelerator are 5 Mev and approximately 1000 amp/burst. Stabilization criteria for the helical-field accelerator are given. (Gmelin Inst.)

Astrophysics and Cosmology

36124 (MIT-2098-60) SMALL-ANGLE SCATTERING BY INTERSTELLAR GRAINS AS A SOURCE OF ANGULAR BROADENING OF CELESTIAL X-RAY SOURCES. James W. Overbeck (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science and Massachusetts Inst. of Tech., Cambridge). [Aug. 3, 1964]. Contract AT(30-1)-2098. 7p.

Cross sections and scattering amplitudes for small-angle refraction of celestial x rays by interstellar grains were investigated to provide evidence for the existence of neutron stars. Initial interest was brought about by an observed occulation of the x-ray source in the Crab Nebula by the moon. (R.E.U.)

36125 THE METRIC OF AN EXPANDING UNIVERSE WITH A LOCALLY NON-HOMOGENEOUS AND ANISOTROPIC MASS DISTRIBUTION. Jaroslav Pachner (Technical Univ., Prague). Acta Phys. Polon., 25: 735-40(May 1964).

Field equations of the relativistic cosmology were solved under assumption of a locally non-homogeneous and anisotropic mass distribution by an approximative method. By a proper substitution the metric was then transformed into the form particularly suitable for cosmological investigations. This form of the metric shows clearly that the influence of the local non-homogeneous and anisotropic mass distribution upon the metric is expressed in the first approximation by the Newtonian potential. The examination of the applied method of solution proves its accuracy to be quite sufficient for determining the motions of stars within a galaxy and of galaxies within a cluster of galaxies. (auth)

36126 RADIAL ADIABATIC PULSATIONS OF GENERALIZED ROCHE MODEL. P. K. Bhatia and R. S. Kushwaha (Univ. of Delhi). Appl. Sci. Res., Sect. A, 12: 454-62(1964).

Small stationary adiabatic radial pulsations of a generalized Roche model were studied. The model is supposed to consist of a homogeneous compressible core of uniform density and a constant γ, the ratio of specific heats for the

stellar material. The core is surrounded by an envelope in which the density varies inversely as the square of the distance from the center and γ decreases continuously from the interface. Moreover, the density is supposed to be continuous across the interface, and the mass of the envelope is not negligible. The variation of γ was taken rather arbitrarily, but a number of particular cases for the values of different parameters of the law of variation were studied. It is found that the model as a whole can have stable oscillations. (auth)

36127 THE QUASI-STELLAR RADIO SOURCES 3C 48 AND 3C 273. Jesse L. Greenstein and Maarten Schmidt (Carnegie Inst. of Washington, Washington, D. C. and California Inst. of Tech., Pasadena). Astrophys. J., 140: 1-34 (July 1, 1964).

The spectra of two quasi-stellar radio sources, 3C 48 and 3C 273, were studied in detail. Conclusions concerning the redshift, luminosity, emission-line, and continuous spectra are presented. Together with the radio-frequency data and the light variability, these indicate the presence of very large total energies in a relatively small volume of space. Explanations for the large redshifts, in particular the possibility of gravitational redshift are considered. The presence of relatively narrow emission lines excludes objects near 1 $M_\odot$ which are stable because of the small emitting volume. The presence of forbidden lines sets an upper limit to the gas density. Together with a limit to gravitational perturbations on our Galaxy, this leads to a lower limit of 10^{11} $M_\odot$, condensed to a 10^{17}-cm radius. Whether such large masses can be even quasi-stable has not yet been demonstrated. The interpretation that the redshifts are cosmological in origin is adopted. The absolute visual magnitudes are about −26 for 3C 273 and −25 for 3C 48. The forbidden lines of high ionization potential are quite strong in 3C 48 relative to hydrogen. By analogy with planetary nebulae and assuming normal abundances, with astrophysical details given in the appendices, the electron density, N_e, is found to be probably near to or less than 3×10^4 cm^{-3}; the electron temperature is not very high, and the mass is about 5×10^6 $M_\odot$ within a radius of 10 pc or more. The emitting volumes are obtained from N_e and the observed luminosity in Hβ and Mg II. The forbidden lines and the Balmer lines are optically thin, but Mg II is optically thick. For 3C 273, in which the forbidden lines are weaker, the surprising weakness of [O II] permits a closer estimate of N_e near 3×10^6 cm^{-3} and a mass of 6×10^5 $M_\odot$ within a radius of about 1 pc. The light variations observed in both, with cycles of 10 years or less, suggest the presence of a source of optical continuum with a diameter of 1 pc, possibly much less. Continued observations of the absolute intensities of lines and continuum and their variations are needed. The thermal energy supply in the H II region is small. The ionized gas must be of low density in the region in which the radio frequencies are generated, because of free-free absorption and Faraday rotation, i.e., $N_e < 10$ cm^{-3} if R = 500 pc for the radio source. Models for synchrotron generation of radio and optical frequencies are investigated. If R = 500 pc, total energies required for radio emission are relatively low, about 10^{57} erg at equipartition. The lifetimes for exhausting the total energy supply are about 10^6 years. If optical synchrotron is obtained from the same volume as produces radio frequencies, the equipartition energy reaches 10^{58} erg. If optical synchrotron radiation is to arise within a volume 1 pc^3, however, the total energy is small, 10^{54} erg, the life about a year, and serious problems arise, such as cosmic-ray proton collisional loss, and inverse-Compton effect electron loss. Models for the jet radio source 3C 273A offer no particular difficulty. Conditions are reviewed under two possible age estimates of the inner components of the quasi-stellar objects. At 10^3 years, the object can be in expansion, with a velocity compatible with the emission-line width, about 1000 km/sec. The energy supply is sufficient for the radio spectrum, and the kinetic energy of the H II region is nearly enough to maintain the optical emission. On this hypothesis, the jet is 3C 273 and the nebular wisps in 3C 48, which are 150,000 light-years in size, must have originated in a separate event. If the age is 10^6 years, the H II region energy is much too small; in addition, its small radius and large internal motion would need to be stabilized by a gravitational mass near 10^9 $M_\odot$, inside the H II region. The radiated energy in 10^6 years is near 10^{60} erg, so that nuclear-energy sources of 10^9 $M_\odot$ are required. The simplest model of the quasi-stellar sources is one in which a small mass of 10^9 $M_\odot$ is surrounded by shells of increasing radius in which the optical continuum, the emission lines, and the radio continuum, respectively, originate. The relation of these objects to the most intense radio galaxies is unclear. The quasi-stellar sources have small optical size, a high ratio of optical to radio emission, and an optical luminosity so high that, if their age exceeds 1000 years, continued input of energy is required from some not directly observable source. A brief résumé of numerical results is given. (auth)

36128 A DISCUSSION OF GALAXIES IDENTIFIED WITH RADIO SOURCES. Thomas A. Matthews (California Inst. of Tech., Pasadena), William W. Morgan, and Maarten Schmidt. Astrophys. J., 140: 35-49(July 1, 1964).

A description is given of the optical forms of the identified extragalactic radio sources for which satisfactory plate material is available. These forms fall into two general categories: weak sources, having luminosities ranging between 10^{38}–10^{40} erg/sec radiated power; and strong sources, having luminosities greater than 10^{40} erg/sec. The spiral galaxies observed to be radio sources are in the weak source category. The most commonly encountered optical forms of the identified extragalactic radio sources are galaxies having elliptical-like inner regions surrounded by an extended envelope (the D systems of Morgan's classification); all of the D galaxies occur in the strong radio-source category. These D-galaxy radio sources frequently have double or multiple nuclei. A special case of the D galaxies with double nuclei is the dumbbells, consisting of two separated, approximately equal, nuclei surrounded by a common envelope; the dumbbells also occur over a range of 10,000 to 1 in radio luminosity. A number of these galaxies occur in clusters of a special kind: clusters of galaxies which are dominated by a single D system, centrally located in its cluster, and very much larger and brighter than any other galaxy in the cluster. A number of other similar clusters of galaxies were found to have a dominating D galaxy in which this galaxy is not a radio source. A list of some of the nearer clusters of this type is given. The radio sources tend to occur in clusters of richness 2 on Abell's system. The most luminous group of extragalactic radio sources is the so-called quasi-stellar sources, which have the optical appearance of stars — sometimes accompanied by faint wisps; four of these objects are listed; they have a range in luminosity of the order of 10. Of somewhat similar optical appearance are the N radio galaxies, which consist of brilliant, starlike nuclei located in relatively smaller

and faint envelopes. The N radio galaxies are easily distinguished from the quasi-stellar sources spectroscopically, in the sense that the spectra of all four quasi-stellar sources have very broad emission lines, while the emission lines in the N sources are much sharper. The N radio sources are in the strong radio-source group, but their mean radio luminosity is of the order of 50 times less than the quasi-stellar sources. The N radio sources tend to have a radio structure which is long and narrow with some small-scale components. The dumbbell radio sources have a marked tendency to have a simple radio structure comprised of a single, nearly symmetrical, Gaussian. The quasi-stellar radio sources have a variety of radio properties, all types of radio structure being present. There are faint optical extensions in NGC 5128, NGC 1316, and NGC 7720 which seem to be intimately related to the radio structure. In both Centaurus A and 3C 33 the radio sources are located near the axis of rotation of the galaxy. No highly flattened galaxies were observed among the strong sources; in this respect they differ sharply from the weak group, the majority of which are highly flattened spirals. The D galaxies are supergiant galaxies having a diameter along major axis which averages 50 kpc, whether they are radio sources or not. Thus, about 60 per cent of radio sources are smaller than, or comparable to, the size of the parent galaxy. The optical evidence is strongly against the earlier interpretation of radio sources in terms of a pair of colliding galaxies; there is not one source where this could be considered a more likely explanation than a single, peculiar galaxy. (auth)

36129 FORMATION OF MASSIVE QUASI-STELLAR OBJECTS. R. H. Miller (Univ. of Chicago) and E. N. Parker. Astrophys. J., 140: 50-2(July 1, 1964).

Enhancement of evaporation from a star cluster through the operation of co-operative phenomena is suggested as a possible mechanism for the formation of compact massive objects from star clusters in times of the order of 10^{10} years. (auth)

36130 ON THE LINEAR POLARIZATION OF THE MICROWAVE RADIATION FROM RADIO SOURCES. G. A. Seielstad, D. Morris, and V. Radhakrishnan (California Inst. of Tech., Pasadena). Astrophys. J., 140: 53-64 (July 1, 1964).

Measurements of the wavelength dependence of the linear polarization of twenty-nine radio sources were compiled. It is confirmed that in the decimeter wavelength range the observed Faraday rotation of the plane of polarization arises in the Galaxy. Although the magnetic field in the local spiral arm must be highly ordered, the data do not allow a definite field configuration to be deduced. The simple model due to Chandrasekhar and Fermi is shown to be untenable, however. The hypothesis that depolarization at decimeter wavelengths is caused by differential Faraday rotation in the Galaxy is rejected for lack of supporting evidence. An inverse correlation between emissivity (or magnetic-field strength) and fractional polarization at 10-cm wavelength is presented. This is interpreted as confirmation of the suggestion by Woltjer that depolarization is produced by Faraday rotation effects within the radio sources themselves. Sources with high magnetic fields will therefore only exhibit detectable polarization at centimeter wavelengths. At these wavelengths they will have large depolarization rates and consequently large rotation measures due to their internal Faraday rotation. Such sources, in contrast to the majority of those studied hitherto, will therefore show poor correlation between rotation measure and galactic latitude and an enhanced correlation with depolarization rate. (auth)

36131 AN INTERSTELLAR CLOUD WITH A HIGH CONCENTRATION OF CN MOLECULES. Guido Muench (Carnegie Inst. of Washington, Washington, D. C. and California Inst. of Tech., Pasadena). Astrophys. J., 140: 107-11(July 1, 1964).

A group of stars embedded in an emission nebula near the cluster NGC 7822 was discovered to have a unique interstellar spectrum, characterized by exceedingly strong CN lines. Evidence is presented favoring the hypothesis that the CN molecules arise in the immediate neighborhood of the H_{II} region boundary. It is further suggested that the CN molecules are formed in the solid particles of the H_I region when flashed by the uv radiation in the advancing ionization front. (auth)

36132 THE STABILITY OF IONIZATION FRONTS. W. I. Axford (Cornell Univ., Ithaca, N. Y.). Astrophys. J., 140: 112-18(July 1, 1964).

The problem of the stability of ionization fronts is considered, making an allowance for the absorption of ionizing photons in the H_{II} region. For weak D-type ionization fronts it is found that the absorption has a stabilizing effect, and that only very short wavelength disturbances remain unstable. A complication which at present prevents an analysis of the stability of strong D-type ionization fronts is discussed briefly. (auth)

36133 THE PLANETARY NEBULA IN THE GLOBULAR CLUSTER M15. C. R. O'Dell (Univ. of California, Berkeley), M. Peimbert, and T. D. Kinman. Astrophys. J., 140: 119-29(July 1, 1964).

The results of a photographic spectrophotometric investigation of the nebulous object K648 in the globular cluster M15 are presented. On the basis of a discussion of the size, density, and mass it is shown that K648 represents a typical example of the planetary nebula phenomena. The relative abundances of hydrogen, helium, oxygen, and neon were determined. The oxygen abundance, relative to hydrogen, is deficient by a factor of 61 relative to the sun. The helium abundance, $N(He)/N(H) = 0.18 \pm 0.03$, is compared with that found in field planetary nebulae, a very high-velocity planetary nebula, and the Orion Nebula. It is shown that strong arguments can be presented, supporting the hypothesis that the original helium content of the globular clusters was much higher than the very low values usually assumed. (auth)

36134 ATMOSPHERIC PHENOMENA IN THE RR LYRAE STARS. I. THE SINGLY PERIODIC VARIABLES. George W. Preston and Bohdan Paczynski (Univ. of California, Mount Hamilton). Astrophys. J., 140: 181-213 (July 1, 1964).

Simultaneous spectroscopic and photoelectric observations of singly periodic RR Lyrae stars show that near mid-rising light hydrogen emission probably occurs in all type a variables, but not in those of types b and c; the strength of the emission varies widely among the type a variables but is nearly the same at all light rises in any one star; the phases of hydrogen emission very nearly coincide with those of the U–B excess; the size of the U–B excess and the strength of the emission are poorly correlated. The possibility that the longward emission found in X Ari arises in infalling gas is discussed briefly. Values of θ_e (= $5040/T_e$) are derived from H_γ absorption profiles. A relation between θ_e and intrinsic color $(B-V)_0$ is derived on the assumption that systematic differ-

ences in the observed color indices of the type a variables are due to interstellar reddening. It is shown that it is possible to determine θ_c from the equivalent width of H_γ alone. A new relation between light range and radial velocity range is derived from the radial velocities given by the metal lines. Variables of all Bailey types define a single relation. The slope of the relation (for photographic light), 48 km sec^{-1} pg mag^{-1}, exceeds that for classical cepheids but is considerably smaller than those derived previously from hydrogen lines. Reasons are given for believing that the hydrogen-absorption velocities during rising light are distorted by the presence of emission. The phase lag between the luminosity and velocity curves is found to be extremely small ($\sim -0^p.005$) for the type a and type b variables, but is of the order of $-0^p.17$ for two type c variables. (auth)

36135 ABUNDANCES IN HIGH-VELOCITY A STARS. II. THE METAL-POOR STAR HD 109995. George Wallerstein (Univ. of California, Berkeley) and William Hunziker. Astrophys. J., 140: 214-20(July 1, 1964).

By comparison with Vega the halo star HD 109995 was found to be deficient in eleven elements from sodium to strontium by a factor of 10. If Sirius is used as the comparison star the metal deficiency is somewhat larger and some strange relative abundances of the elements appear. In particular scandium and calcium are in excess and strontium and barium are deficient. This discrepancy is explained as due to the particular composition of Sirius. The composition of all sharp-lined A dwarfs for which equivalent widths were published were intercompared. (auth)

36136 ON THE INFLUENCE OF THE CHEMICAL COMPOSITION ON THE STRUCTURE AND METAL INDEX OF STELLAR ATMOSPHERES. David Fischel (Indiana Univ., Bloomington and Ames Research Center, Moffett Field, Calif.). Astrophys. J., 140: 221-34(July 1, 1964).

A series of model stellar atmospheres, representing stars of normal and low heavy-element abundance in the spectral range F0–K0, were calculated. Characteristics of the emergent flux of the models, particularly the metal index and (v, b, y)-colors of Strömgren's narrow-band photometric system, are discussed and compared with observations. (auth)

36137 THE WIDTH OF H_α AS A DISCRIMINANT OF LUMINOSITY IN THE SPECTRA OF LATE-TYPE STARS. Robert P. Kraft (Carnegie Inst. of Washington, Washington, D. C. and California Inst. of Tech., Pasadena), George W. Preston, and Sidney Carne Wolff. Astrophys. J., 140: 235-49(July 1, 1964).

It is shown that the width H_0 of the core of H_α in absorption in the spectra of late-type stars increases with increasing luminosity. Among G- and K-type stars a correlation, independent of spectral types, exists between log H_0 and the absolute ultraviolet magnitude M_U. Among M-type stars, giants cannot be distinguished from supergiants, but dwarfs can be easily differentiated from giants. The relation fails for Class IV stars of all spectral types because of the influence of damping wings. Emission probably distorts the absorption profiles of H_α in many supergiants later than K2. It is suggested that the core of H_α is Doppler in origin and arises in the chromosphere; the correlation is seen as an analog of the Wilson-Bappu effect in the emission of the K-line of Ca_{II}. Some astrophysical consequences of this identification are explored using a simple slab model. The log H_0 versus M_U correlation can be more readily applied than the K-line method in galactic-structure studies but is somewhat less accurate in practice. Several comparisons are made between K2 and H_α as indicators of luminosity in late-type stars. (auth)

36138 IRREVERSIBILITY IN SMALL STELLAR DYNAMICAL SYSTEMS. R. H. Miller (Univ. of Chicago). Astrophys. J., 140: 250-6(July 1, 1964).

Irreversibility in stellar dynamical systems was studied by means of numerical experiments using n-body calculations carried out in a computer for n up to 32. In the experiments, two similar systems evolve simultaneously and the separation of their representative points in phase space was observed to grow exponentially with the time variable because of the effects of encounters. The time constant of this exponential growth defines a relaxation time different from the usual relaxation time of stellar dynamics. Certain properties of the calculation and comparisons of the observed values of this relaxation time with values expected on the basis of binary collisions led to the conclusion that n-body systems with inverse-square law forces behave as tightly coupled systems. The time constant is surprisingly short — about $4\tau/n$, where τ is the mean time between binary collisions of one particle. Hard spheres or r^{-6} potentials do not show the collective behavior of inverse-square law systems. Errors in calculations of n-body systems grow exponentially with the time through this mechanism, and may therefore invalidate the results of n-body calculations. (auth)

36139 INSTABILITY OF THE EQUIPARTITION STATE IN A FLUID SPHERE. Jerome Kristian (Univ. of Texas, Austin). Astrophys. J., 140: 257-67(July 1, 1964).

Perturbations of a toroidal equipartition state in a homogeneous, compressible sphere are investigated in the tensor virial approximation. The equipartition state mixes the radial pulsation and the lowest-order Kelvin oscillation of the sphere. For any fluid, the sphere is unstable if the magnetic energy M exceeds a critical value. This value depends upon γ, the ratio of specific heats of the fluid, but in no case is it larger than $\frac{1}{3}$ of the gravitational energy of the sphere. For $\gamma < \frac{6}{5}$, it is the radial model which becomes unstable: for $\gamma > \frac{6}{5}$, it is the Kelvin mode. For $\gamma = \frac{6}{5}$, neither of the lowest modes reduces to either the radial mode or the Kelvin mode in the limit of small M. The results are examined in the limit of large γ (nearly incompressible fluid). (auth)

36140 ON THE STELLAR-WIND EQUATIONS. Erling Dahlberg (Royal Inst. of Tech., Stockholm). Astrophys. J., 140: 268-75(July 1, 1964).

It is shown how Parker's polytrope-law coronal expansion equations can be simplified, analytically and physically, through the introduction of the locally defined variables $M^2 = u^2 m_i / a2kT$ and $\lambda = Gm_\odot m_i / kTr$. Specifically, two new forms of the flow integral are found: one where the variables are separated $f(M^2) = g(r/r_0)$; and one $F(\lambda, M^2) =$ const., which clearly shows the one-parameter character of the solutions and allows the presentation of all possible types in four $M^2\lambda$-diagrams. Some omissions in Parker's exposition become evident, i.e., there exists, for $\frac{3}{2} < a < \frac{5}{3}$, a decelerating subsonic-supersonic transition solution yielding zero pressure at infinity. (auth)

36141 THE MEAN NUMBER OF SCATTERINGS BY A RESONANCE-LINE PHOTON. D. G. Hummer (Joint Inst. for Lab. Astrophysics, Boulder, Colo.). Astrophys. J., 140: 276-81(July 1, 1964).

A rigorous upper bound to the mean number of scatterings $\langle N \rangle$ experienced by a resonance-line photon is obtained very simply. For completely non-coherent scattering this

bound provides a good estimate of ⟨N⟩, and explicit expressions are obtained for the cases of Doppler, Voigt, and Lorentz absorption coefficients. These results are contrasted with those of Osterbrock and are interpreted in terms of the concept of effective band width. (auth)

36142 EVALUATION OF FREE-FREE ABSORPTION COEFFICIENT OF THE NEGATIVE HYDROGEN ION. Takashi Ohmura (Stanford Research Inst., Menlo Park, Calif.). Astrophys. J., 140: 282-4(July 1, 1964).

The continuous absorption coefficient due to the free-free transitions of the negative hydrogen ion is evaluated by the most accurate theoretical technique feasible at the present time and by the best data available for the elastic scattering of electrons by hydrogen atoms. (auth)

36143 EFFECTS OF ERRORS IN THE ABSORPTION COEFFICIENT ON THE NON-GRAY MODEL STELLAR ATMOSPHERES. Satoshi Matsushima and Yoichi Terashita (Univ. of Iowa, Iowa City). Astrophys. J., 140: 285-7 (July 1, 1964).

The effect on the non-gray model-atmosphere calculation due to errors of 10-50 per cent in the continuous opacity is examined by constructing two solar-type model atmospheres in which different H^- absorption coefficients are used. In Model I the old values of Chandrasekhar and his associates for both the bound-free and free-free absorption of H^- are adopted, while in Model II the values recently revised by Geltman, and by Ohmura and Ohmura are used. The values for the bound-free absorption differ by 10 per cent in the visible region, and those for the free-free absorption by 40–50 per cent in the infrared. Other than H^-, only neutral hydrogen is taken into account as a source of opacity. The computation is based on the Avrett-Krook iterative procedure which yields a model strictly in radiative equilibrium. It was found that the temperature-pressure relations of the two models differ by only a fraction of 1 per cent. On the other hand, a comparison of the color distribution of emergent flux reveals variations comparable to the differences in the absorption coefficients. The direction of flux variation due to the change in opacity is interpreted on the basis of the condition of flux constancy. (auth)

36144 THE PROPAGATION OF ACOUSTIC WAVES THROUGH THE SOLAR CHROMOSPHERE. G. A. Bird (Univ. of Sydney). Astrophys. J., 140: 288-91(July 1, 1964).

Consideration is given to the acoustic disturbances produced by a piston oscillating with the frequency and amplitude characteristic of the photospheric granules. The method of characteristics is used to obtain numerical solutions of the full non-linear equations of motion. It is found that shock waves are formed within distances of the order of 1000 km. These shock waves are expected to propagate through the chromosphere with their strengths virtually unaffected by the atmosphere. It is concluded that the results of linearized theory must be treated with caution. (auth)

36145 EXCITATION IN ATOMIC COLLISIONS RELATED TO METEOR RADIATION. S. H. Neff (Harvard Univ., Cambridge, Mass.). Astrophys. J., 140: 348-60 (July 1, 1964).

Cross sections were measured for the production of atomic and molecular emissions in the spectral region of 3700-6400 Å in collisions between Ar^+, N_2^+, Ne^+, Mg^+, K^+, Na^+, and Ca^+ with N_2 and Ar^+ and N_2^+ with Ar, in the energy range of 400–2000 ev. The largest cross sections measured were for the excitation of the D-lines in Na_I ($\approx 1 \times 10^{-17}$ cm^2) and the K-line in Ca_{II} ($\approx 2 \times 10^{-17}$ cm^2). A general analysis of the results shows s^1 and s^2 configuration usually more easily excited than p^5 and p^6 configuration, and suggests that the excitation of the N_2^+ negative bands is closely related to charge exchange. The reactions involving Na^+, Mg^+, and Ca^+ are of importance with regard to meteor radiation. (auth)

36146 RADAR EVIDENCE OF SOLAR WIND AND CORONAL MASS MOTIONS. J. H. Chisholm and J. C. James (Massachusetts Inst. of Tech., Cambridge). Astrophys. J., 140: 377-9(July 1, 1964).

Radar measurements of the solar corona are reported. Spectral studies of the solar echo imply a solar wind and suggest coronal mass motions with a velocity spectrum of ~ ±35 km/sec at a depth in corona where the radio energy is reflected. (C.E.S.)

36147 COMPUTER RESULTS ON COMBINED HYDROGEN AND HELIUM BURNING. Georgeanne R. Caughlan, William A. Fowler, and Raymond J. Talbot (Montana State Coll., Bozeman and California Inst. of Tech., Pasadena). Astrophys. J., 140: 380-3(July 1, 1964).

The differential equations for abundances involved in combined hydrogen and helium burning were solved. The results show good agreement with a previous analysis and provide additional detail concerning the sensitivity to the number of protons introduced into the edge of the helium core. (C.E.S.)

36148 LUMINESCENCE OF ENSTATITE ACHONDRITE METEORITES. C. J. Derham, J. E. Geake, and G. Walker (Manchester Coll. of Science and Tech., Eng.). Nature, 203: 134-6(July 11, 1964).

Luminescence from enstatite achondrite meteorites under proton excitation is discussed. The spectra have a weak blue peak at ~4000 Å and a strong red peak at ~6700 Å. The meteorites were separated into their main components, and it was found that the enstatite was responsible for all observed luminescence. The luminescence efficiency was also discussed. (C.E.S.)

36149 STRUCTURE OF THE SOLAR CHROMOSPHERE. P. A. Sturrock (Stanford Univ., Calif.). Nature, 203: 285-6 (July 18, 1964).

The radially increasing temperature of the solar atmosphere ascribed to propagation of nonthermal energy such as acoustic waves is discussed. The energy carried by vertically propagating acoustic waves is considered. The sharp transition from the chromosphere to the corona is explained by means of the acoustic wave propagation model. (C.E.S.)

36150 NEUTRINO PRODUCTION IN MASSIVE HELIUM-STAR MODELS. M. Cimino, P. Giannone, M. A. Giannuzzi, A. Masani, and N. Virgopia (Osservatorio Astronomico, Rome and CNR, Rome). Nuovo Cimento (10), 33: 663-4(July 16, 1964).

The luminosity and the energy/sec which escapes in neutrino photoproduction were calculated for eight equilibrium models with central temperatures of the order of some units in 10^8K and central densities between a few hundred and a few thousand g/cm^3. Photoproduction exceeds pair annihilation neutrinos by at least a factor of 10^{10}. (D.C.W.)

36151 THE INTERACTION OF THE SOLAR WIND WITH COMETS. W. I. Axford (Cornell Univ., Ithaca, N. Y.). Planetary Space Sci., 12: 719-20(July 1964).

Type I comet tails are widely attributed to an interaction

of the solar wind and molecules evaporated from the comet nucleus, the molecules being ionized and swept along by the solar wind through the action of the interplanetary magnetic field. The likely presence of a shock wave in the medium upstream from the nucleus when a type I tail is well developed is discussed, together with some of its possible effects. (D.C.W.)

36152 THE STREAMING OF SOLAR FLARE PARTICLES AND PLASMA IN INTERPLANETARY SPACE. Tatsuzo Obayashi (Kyoto Univ.). Space Sci. Rev., 3: 79-108(July 1964).

A review is given of the features of solar particle emissions which cause various terrestrial disturbances. Three types of corpuscular emissions, namely, solar cosmic rays, energetic storm protons, and plasma clouds, are associated with intense solar flares. Outward streaming of the solar wind and of beams of enhanced activity originate from the quiescent solar corona. It is shown that these solar particles propagate through interplanetary space, being modulated in a systematic way by existing magnetic fields. Time variations of solar flare particle flux, and their energy spectrum, are discussed. (auth)

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Refer also to abstracts 36145 and 36355.

36153 (BNL-7180) WAVE FUNCTIONS FOR QUADRUPOLE ANTISHIELDING FACTORS. R. M. Sternheimer (Brookhaven National Lab., Upton, N. Y.). July 10, 1963. Contract [AT(30-2)-Gen-16]. 15p.

Supplement to Phys. Rev. 132: (1963).

Tables are given of perturbed wave functions obtained in a calculation of the quadrupole antishielding factors for F^-, Br^-, Rb^+, Pr^{3+}, and Tm^{3+}. The original calculations were abstracted in NSA 18: 237. (R.E.U.)

36154 (NASA-TN-D-2408) MOBILITY OF POSITIVE IONS IN THEIR OWN GAS: DETERMINATION OF AVERAGE MOMENTUM-TRANSFER CROSS SECTION. John W. Sheldon (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). Aug. 1964. 20p.

The energy-dependent charge-exchange cross section is integrated over the appropriate energy distribution to yield the average momentum cross section for an ion in its own gas. This momentum cross section $\overline{Q}$ is presented in terms of charge exchange constants A and B, numerical constants $\overline{E} = 0.577\ldots$ and $\overline{K} = 2.492\ldots$, the atomic polarizability α, and the thermal energy of the gas kT. The expression obtained is shown to have an error $\Delta\overline{Q}/\overline{Q}$ of less than $1.15\ \alpha/[(AB)^2 + 5\alpha]$. The average momentum cross section obtained from the equation can be used to compare energy-dependent charge-exchange cross section data with mobility data; this is illustrated by an example for several inert gas ions in their own gas. The average momentum cross section was also used to compute the mobility of alkali-metal ions in their own vapor. The calculations reveal errors in earlier numerical approaches. (auth)

36155 (TID-20873) FINAL REPORT [ON PHYSICS]. Elias Burstein (Pennsylvania. Univ., Philadelphia). July 21, 1964. Contract AT(30-1)-2395. 14p.

Research is reported on: infrared and Raman lattice vibration spectra; Fermi surfaces of metals and semimetals; energy-band structure of semiconductors; and electron tunneling in semiconductors and superconductors. (T.F.H.)

36156 A Tl–Hg COLLISION CROSS SECTION. E. E. Step and R. A. Anderson (Univ. of Missouri, Rolla). Phys. Letters, 11: 127-8(July 15, 1964).

The lifetime of the 6^3P_1 state of Hg was measured as a function of Tl density at two different Hg pressures. From these data it appears that at high Tl densities the lifetime of the 6^3P1 state of Hg is controlled by collisions with Tl atoms. Using this assumption and gas kinetic theory, a cross section for these collisions was calculated. (C.E.S.)

36157 EXCITATION AND IONIZATION OF HYDROGEN ATOMS BY ELECTRON IMPACT. A. E. Kingston. Phys. Rev., 135: A1529-36(Sept. 14, 1964).

The classical cross sections of Grysinski for the excitation and ionization of atomic hydrogen by electron impacts are compared with existing experimental and theoretical cross sections. For excitation from the ground to the first excited states of atomic hydrogen, the classical cross section reproduces the experimental cross section to within a factor of 2 from the excitation threshold to an electron impact energy of about 20 atomic units. For ionization from the ground state of atomic hydrogen, the classical cross section reproduces the experimental cross section to within a factor of 2 from 0.02 atomic units above threshold to about 400 atomic units. A comparison of the classical cross sections with all available Born-approximation cross sections shows that although the classical cross sections are always smaller, they agree quite well with the Born cross sections except at very high energies. However for energies less than 100 atomic units the classical cross sections always agree with the Born cross sections to better than a factor of three. A comparison of experimental electron-ion recombination coefficients and theoretical recombination coefficients, obtained by using the classical cross sections, suggests that at low energies, the classical cross sections for transitions between low excited levels cannot be in error by more than a factor of 2. (auth)

36158 CALCULATION OF CROSS SECTIONS FOR ELECTRON IONIZATION OF ATOMS USING CLASSICAL MECHANICS. A. E. Kingston (Univ. of Colorado, Boulder). Phys. Rev., 135: A1537-9(Sept. 14, 1964).

In order to determine the range of validity of Gryzinski's classical theory for inelastic electron-atom scattering, we evaluate exactly the classical cross section for the electron ionization of atomic hydrogen. At large electron-impact energies the exact classical cross section disagrees with the experimental cross section. This is due to the inability of the classical theory to describe an electron-atom collision if the energy of the incident electron is large. For low-impact energies the classical description of a collision becomes valid. The electron energy at which the classical theory becomes applicable is in good agreement with the energy predicted by the uncertainty principle. (auth)

36159 POLARIZATION EFFECTS IN THE ELASTIC SCATTERING OF ELECTRONS FROM HELIUM. R. W. LaBahn (Naval Ordnance Lab., Corona, Calif. and Univ. of California, Riverside) and Joseph Callaway. Phys. Rev., 135: A1539-46(Sept. 14, 1964).

The cross section for elastic scattering of electrons from helium atoms was computed for an energy range from 0 to 50 ev. The formalism used was obtained from an extension of Hartree-Fock theory wherein the distortion induced in the atom by the scattering electron is approximated by a polarization potential. The method is similar to the adiabatic-exchange treatment of electron-hydrogen scattering by Temkin and Lamkin. The computed scattering phase shifts and cross sections are compared with various

other calculations and experimental data. A scattering length of 1.13 a_0 is extrapolated from the phase shifts after correcting them for the effects of truncating the polarization interaction as required in the iteration process. The computed total cross sections compare favorably at low energies with the data of Ramsauer and Kollath and at very low energies with the modified effective-range theory of O'Malley, Spruch, and Rosenberg. The differential scattering cross sections follow the effective-range theory in a high backward asymmetry at low energies and the experimental data in a high forward symmetry at higher energies. The momentum-transfer cross sections agree well with recent microwave drift-velocity measurements, especially those of Pack, Phelps, and Frost. (auth)

36160 RADIAL WAVE FUNCTIONS FOR THE CESIUM ATOM. Herbert A. Moses and Arnold Russek (Univ. of Connecticut, Storrs). Phys. Rev., 135: A1547-9(Sept. 14, 1964).

The radial wave functions for 26 electronic orbitals of the cesium atom are presented. For each orbital the electron is considered to move in a screened Coulomb potential which is taken to be approximately the Thomas-Fermi potential for a singly charged cesium ion. The states obtained here are improvements over those obtained by Russek, Sherman, and Flinchbaugh, and extend the scope of that work as well. (auth)

36161 THOMAS-FERMI THEORY OF EXCITED ATOMIC STATES. Nandor L. Balazs and Richard A. Mould (State Univ. of New York, Stony Brook). Phys. Rev., 135: A1560-5(Sept. 14, 1964).

The usual Thomas-Fermi theory of the atom applies only to ground states. The general method of extending the theory to excited states is outlined, and this program is carried out for the case of a one-dimensional atom. The treatment is completely self-consistent and yields a nonlinear differential equation that must be solved simultaneously with other equations expressing Bohr-Sommerfeld quantization conditions. Numerical computations show the magnitude of core polarization effects arising from the self-consistent field. (auth)

36162 IONIZATION OF HELIUM, NEON, AND NITROGEN BY HELIUM ATOMS. Howard C. Hayden and Nyle G. Utterback (Univ. of Denver). Phys. Rev., 135: A1575-9 (Sept. 14, 1964).

The ionization cross sections for He and Ne atoms and N_2 molecules on impact with He atoms were measured over the laboratory energy range from 30 to 1000 ev. The incident atomic He beam was produced by the technique of ionization by electron impact, electrostatic acceleration, and neutralization by charge transfer. The measurements were carried out in a low-pressure parallel-plate ionization chamber. Particular attention was paid to the problem of secondary electrons. The ionization cross section obtained for the He–He and He–Ne interactions were one to two orders of magnitude smaller than the N_2–N_2, N_2–O_2, and O_2–O_2 cross sections studied earlier. The He–N_2 cross section was found to be of the same order of magnitude as the N_2–N_2 cross section. Data were also obtained on He^+-in-He charge transfer and secondary-electron emission from a gold surface by He ions and atoms. (auth)

36163 MACHINE SIMULATION OF COLLISIONS BETWEEN A COPPER ATOM AND A COPPER LATTICE. Warren L. Gay and Don E. Harrison, Jr. (Naval Postgraduate School, Monterey, Calif.). Phys. Rev., 135: A1780 (Sept. 14, 1964).

A number of collision events in which the target atom is embedded in a crystal lattice were examined. The f-c-c ⟨100⟩, ⟨110⟩, and ⟨111⟩ orientations were examined in detail for the energy range from 25 ev to 10 kev. Preliminary results for the b-c-c ⟨100⟩ lattice are included. Lattice effects are somewhat smaller than one might anticipate. Orientation effects are significant because the relative atomic separations vary considerably between different oreintations. The general features of the results are insensitive to the form of interaction potential, but magnitudes vary considerably. For the Gibson No. 2 parameters in a Born-Mayer potential, lattice effects lose significance around 5-kev bombardment energy; for the Gibson No. 1 they persist to at least 10 kev. No effective mass behavior was detectable. Binary-collision theories are not valid for energies below a few hundred ev. (auth)

36164 ASYMMETRY EFFECTS IN ATOM-MOLECULE COLLISIONS. [PART] I. J. Reuss (Universiteit, Nijmegen, Netherlands). Physica, 30: 1459-64(July 1964).

For rotating molecules, scattered by particles of radial symmetry, the total elastic collision cross section is investigated. It is assumed, that the scattering takes place in a region, where a weak magnetic field is applied. Asymmetric terms in the intermolecular potential are taken into account as a small perturbation. The final result can be used to analyze experimental data obtained in scattering experiments with polarized molecular beams. (auth)

36165 ASYMMETRY EFFECTS IN ATOM-MOLECULE COLLISIONS. [PART] II. J. Reuss (Universiteit, Nijmegen, Netherlands). Physica, 30: 1465-9(July 1964).

The total elastic collision cross section depends on the quantum numbers j and m_j, if molecules with rotational angular momentum $\hbar\sqrt{j(j+1)}$ collide with atoms of radial symmetry. m_j is the component of j measured in the direction of the relative velocity of the colliding particles. This dependency was previously described for cases where the intermolecular potential is of the form $V = V_0(r) + P_2(\hat{r} \cdot \hat{r}') \cdot V_2(r)$. $\hat{r} \cdot \hat{r}'$ is the cosine of the angle between the relative velocity and the molecular axis. The intermolecular potential is specified as $V = -C/r^6 - P_2(\hat{r} \cdot \hat{r}') \cdot C'/r^6$. The conditions are assumed to hold, which justify the use of the Massey and Mohr approximation. The cases $j = 1$ and $j \gg 1$ are discussed. (auth)

36166 LONG-LIVED HIGHLY EXCITED STATES OF POSITIVE IONS. S. E. Kupriyanov, Z. Z. Latypov, and A. A. Perov (Karpov Inst. of Physics and Chemistry, Academy of Sciences, USSR). Zh. Eksperim. i Teor. Fiz., 47: 21-3(July 1964). (In Russian)

Experimental data on stripping and ionization of He^+, Xe^+, Xe^{2+}, and Xe^{3+} ions near a metallic surface are presented. It is shown that highly excited ions are present in the beams of these ions and that their states are close to those of a continuous spectrum. These ion states are long-lived. It is also noted that such states can be found in other ions. (auth)

36167 DETECTION OF LONG-LIVED EXCITED IONS OF THE NOBLE GASES AND MERCURY. S. E. Kupriyanov and Z. Z. Latypov (Karpov Inst. of Physics and Chemistry, Academy of Sciences, USSR). Zh. Eksperim. i Teor. Fiz., 47: 52-60(July 1964). (In Russian)

Ionization of neutral Hg, Xe, Kr, Ar, and Ne atoms by electrons leads to the formation of various singly, doubly, and triply charged excited ions with lifetimes $T \gtrsim 10^{-6}$ sec; only singly charged excited ions were detected for He. On basis of the potentials at which the ions appear it is con-

cluded that the excited ions are produced in states which are close to those of their subsequent ionization. Determination of the excitation energy of the ions is carried out by the method of secondary ionization of the ions. (auth)

36168 COLLISIONS ACCOMPANIED BY CHARGE EXCHANGE. I. Poluektov, L. Presnyakov, and I. Sobelman (Lebedev Inst. of Physics, Moscow). Zh. Eksperim. i Teor. Fiz., 47: 181-7(July 1964). (In Russian)

A new formulation of the charge exchange problem is presented which in the quasi-classical approximation leads to an equation set with an Hermite matrix. A general approximate formula for charge exchange probability is obtained which can be applied for arbitrary colliding particle velocities. The $H^+ + He(1s^2) \rightarrow H(1s) + He^+$ charge exchange cross section calculated on basis of this formula yields satisfactory results. (auth)

36169 INTERACTION BETWEEN NEGATIVE IONS AND ATOMS. B. M. Smirnov and O. B. Firsov. Zh. Eksperim. i Teor. Fiz., 47: 232-9(July 1964). (In Russian)

The properties of a system produced as a result of close encounters between an atom and negative ion are investigated. It is assumed that the interaction between the electron and atom is significant in a restricted region of the order of atomic dimensions and that the weakly bound electron does not affect the properties of the atoms. The dependence of the electron binding energy on the distance between the nuclei is found for the model in the case when the distances are much greater than the atomic dimensions. On this basis a relation between the electron binding energy and resonance charge exchange cross section and cross section for negative ion decay in atomic collisions is derived. A system consisting of spin $\frac{1}{2}$ atoms and an electron is considered. It is shown that in the general case splitting of the energy level of an electron in the field of two widely separated spin $\frac{1}{2}$ identical atoms (ions) is two times smaller than in the case when the atoms are spinless. This result is important in calculating the resonance charge exchange cross section in slow collisions. The possibility of determining the binding energy of negative ions on basis of the experimental values of the decay and charge exchange cross sections is studied for collisions between the negative ions and atoms. (auth)

36170 USE OF β BACKSCATTERING FOR MEASURING SURFACE DENSITY. H. Langel (Frieseke and Hoepfner GmbH, Erlangen, Ger.). p.307-16 of "Atomstrahlung in Medizin und Technik." Munich, Verlag Karl Thiemig KG, 1964. (In German)

The principles of β backscattering are discussed. Applications in which β backscattering is more advantageous than penetration beam measurements or in which β backscattering allows a continuous and more accurate measurement are described. An example of the latter is the measurement of galvanic layers. (J.S.R.)

36171 THREE PARTICLE SYSTEMS WITH COULOMB INTERACTION IN THE GROUND STATE. M. Schroeder. Thesis, Freiburg i. B., Universität, 1963. 45p. $2.00 (Gmelin, AED-DISS. 63-371). (In German)

A theoretical model for the description of atoms and molecules consisting of 3 particles with different mass is given. Molecules of the type H_2^+ are treated in detail because they play an important role in the theory of chemical bonds. Constitution and properties of molecules are investigated using a special variation function with only a small number of parameters. The probability of nuclear fusion due to oscillations of muon molecules is calculated. Eigenfunctions of the nucleon oscillations are determined by numerical integration. Applications of the model to He-type molecules are given. (Gmelin Inst.)

36172 THE APPLICATION OF THE QUANTUM MECHANICAL THREE BODY PROBLEM TO NONLINEAR 3 ATOMIC MOLECULES. A. Weigun. Thesis, Freiburg i. B., Universität, 1963. 50p. $2.00(Gmelin, AED-DISS. 63-370). (In German)

A method for complete theoretical treatment of rotations and oscillations of nuclei in nonlinear triatomic molecules is given. The Schroedinger equation is transformed into a coordinate system that depends on the axis system of the inertia tensor. Invariance, conservation of parity, and hermiticity of the transformed hamilton operator is studied. The general theory is applied to molecules using expansion of the hamilton operator for small oscillation amplitudes. (Gmelin Inst.)

36173 THE TREATMENT OF THE ISOTROPIC ELECTRON-PHONON SYSTEM USING THERMODYNAMIC GREEN'S FUNCTIONS ACCORDING TO MARTIN AND SCHWINGER. R. Klein. Thesis, Brunswick, Technische Hochschule, 1963. 53p. $2.00(Gmelin, AED-DISS. 63-426). (In German)

Electric conductivity is calculated using Green's functions. A transport equation for the Laplace transformation of the corresponding correlation function is given. This transport equation is solved for the lowest order. The general theory of Martin and Schwinger is applied to the conductivity of an electron-phonon system. (Gmelin Inst.)

36174 DEFORMATION OF THE THOMAS-FERMI ATOMIC MODEL BY NON-SYMMETRIC POTENTIAL FIELDS. E. Teuchert. Thesis, Cologne, Universität, 1963. 40p. $2.00(Gmelin, AED-DISS. 63-428). (In German)

Numerical calculation methods of the deformation of the Thomas-Fermi model by nonsymmetric fields using digital computers are given. The deformability of the electron shell in outer regions causes for the simple model a polarizability of the atom, which is too small. The exchange-corrected model gives better results, but still has no satisfactory accuracy. It is concluded that these models can only be used with certain limitations. (Gmelin Inst.)

36175 STUDIES OF DISSOCIATION PROCESSES IN VARIOUS GASES BY COLLISIONS WITH α PARTICLES AND ELECTRONS UP TO 3000 ev. W. Mueller-Duysing. Thesis, Hamburg, Universität, 1963. 106p. $2.00(Gmelin, AED-DISS. 63-472). (In German)

Dissociation processes and ion-molecule reactions in various gases are studied using mass spectroscopy. Electrons between 70 and 3000 ev and Po α-rays were used for primary ionization. The intensity distribution of primary ions is nearly independant of radiation energy and type. This confirms the assumption that ionization and dissociation processes depend on the velocity but not on the mass of the colliding particle. For higher gas pressures secondary ions from ion-molecule reactions change the intensities greatly. Results of measurements of relative ion intensities for various gases are given. Cross sections for the most important reactions are tabulated. (Gmelin Inst.)

36176 ENERGY-LOSS DISTRIBUTION OF PROTONS WHICH HAVE PASSED THROUGH VERY THIN CARBON FILMS. Arthur Lee Morsell, III. Thesis, Madison, Wis., Univ. of Wisconsin, 1964. 145p.

An experimental arrangement employing two cylindrical

electrostatic analyzers of 1-meter radius was used to measure energy-loss distributions produced by thin carbon films for protons with an initial energy of 992.4 kev. The nearly monoenergetic beam from the first analyzer traverses the target film before entering the second analyzer, which is caused to sweep over a convenient range of proton selection energies by a small saw-tooth sweep voltage superposed on the steady potential of one of the analyzer plates. Proton counts produced by a solid state detector at the second analyzer exit are sorted according to the instantaneous value of the sweep voltage to provide a direct measurement of the distribution of changes in proton energy. A combined resolution for the two analyzers of 30,000 was obtained. Carbon films with thicknesses corresponding to mean energy losses ranging from several kev down to less than 200 ev were studied. Several of the experimental distributions are compared with energy-loss distributions computed by Monte Carlo techniques for three different assumed discrete energy-loss spectra. A good fit to the experimental data is obtained from a discrete energy-loss spectrum based on computations by E. Merzbacher. The significance of these comparisons is impaired by uncertainties in the experimental data. The most serious difficulty involves the unknown degree of nonuniformity of target thickness associated with each measured energy-loss distribution. (Dissertation Abstr., 24: No. 12, Pt. I(June 1964))

36177 MOLECULAR BEAM REACTIVE SCATTER APPARATUS (Engineering Materials). (California. Univ., Berkeley. Lawrence Radiation Lab.). (CAPE-1045)

Drawings (35) are included for a crossed molecular beam apparatus for use in the study of chemical reactions. For a listing of individual titles, see the Engineering Materials List (TID-4100). (D.E.B.)

Cosmic Radiation

36178 (AFOSR-424) FINAL REPORT, 1 OCTOBER 1962 TO 30 SEPTEMBER 1963. R. R. Brown (California. Univ., Berkeley). Mar. 1964. 8p. (AD-433709)

Experimental and theoretical studies of cosmic radiation are summarized. The experimental data are collected at balloon altitudes at high latitudes. (T.F.H.)

36179 (NASA-TN-D-2404) A SIMPLE MODEL OF THE INTERPLANETARY MAGNETIC FIELD. PART II. THE COSMIC-RAY ANISOTROPY. David Stern (National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.). Aug. 1964. 10p.

Three explanations for the observed cosmic ray anisotropy are investigated. The possibility that the anisotropy is due to trapped orbits in the interplanetary magnetic field is explored by analyzing the motion of charged particles in the stretched dipole field developed in Part I of this study, published separately. It is found that an anisotropy is possible, but only when several unlikely conditions are met. Two other theories of the anisotropy, ascribing it to a sunward flux density gradient or to the Compton-Getting effect, are then discussed. It is shown that in general both effects occur together; for conservative fields they cancel each other and no anisotropy occurs, as indeed might be expected from Liouville's theorem. Consequently, any gradient of cosmic ray flux density, which might be measured in interplanetary space, is not necessarily connected with the observed anisotropy. (auth)

36180 ENERGY SPECTRUM OF DIURNAL COSMIC-RAY VARIATIONS AND DIURNAL TEMPERATURE VARIATIONS AT A HEIGHT OF 20-40 KM. A. I. Kuz'min, G. V. Skripin, P. A. Krivoshapkin, and G. F. Krymskii (Inst. of Cosmic-Physical Studies and Aeronomy, Academy of Sciences, Siberian SSR). Geomagnetism Aeronomy (USSR) (English Transl.), 3: 672-5(1963).

Continuous cosmic-ray measurements underground at depths of 0, 7, 20, and 60 m of water equivalent (m w.e.) in the vertical direction and at zenith angles of 30° and 60° to the south and north in Yakutsk made it possible to divide diurnal cosmic-ray variations into an atmospheric and an extra atmospheric component and to determine diurnal temperature variations at heights from 20 to 40 km. The diurnal temperature variations have an amplitude of 3 to 4° with a maximum at 3 to 4.5 hr LT. The extraterrestrial component of diurnal cosmic-ray variations is due to particles of an energy $E \geq 7 \pm$ Bev and has a power-law energy spectrum with an exponent of 0.5 ± 0.1. (auth)

36181 THE LUNAR-DIURNAL VARIATION AND THE 27-DAY MODULATION OF COSMIC-RAY ANISOTROPY. L. I. Dorman and L. Kh. Shatashvili (Inst. of Geophysics, Academy of Sciences, Georgian SSR). Geomagnetism Aeronomy (USSR) (English Transl.), 3: 786-8(1963).

The amplitude of lunar-diurnal variations of cosmic radiation was analyzed by lunar phases, and the effect of solar rotation on the anisotropy of cosmic rays was investigated. The results confirm the reality of 27-day variations in the anisotropy of cosmic rays. (D.C.W.)

36182 ON THE ANISOTROPY OF THE COSMIC RADIATION. [PART] II. R. G. Bingham and E. W. Kellermann (Univ. of Leeds, Eng.). Nuovo Cimento (10), 33: 45-8 (July 1, 1964).

Recordings were continued of penetrating cosmic air showers which were previously reported as giving indications of sidereal diurnal variations. It is found that showers due to primaries of about 10^{15} ev exhibit some variations which in themselves are not wholly significant but which must be considered jointly with those reported by others. It is thought that there is some cumulative evidence of anisotropy of 10^{15} ev primaries, but that this could be confirmed only by experiments singling out this energy region and yielding much better statistics. (auth)

36183 GALACTIC AND EXTRAGALACTIC PROPAGATION OF COSMIC RAYS. Howard Laster (Cambridge Univ., Eng. and Univ. of Maryland, College Park). Phys. Rev., 135: B1274-9(Sept. 7, 1964).

A model for the origins of cosmic radiation is examined in which nonsolar primaries below 10^{17} ev are assumed to come from supernovas within the spiral arms of our galaxy, and those at higher energies are attributed to extragalactic sources. Supernova-produced particles are taken as diffusing first in the spiral arm region, then leaking into the galactic halo where they travel with a larger diffusion mean free path, and eventually diffusing into extragalactic space. These particles would be observed with the characteristic energy and mass spectra with which they are injected into the spiral arms, except in the energy range $10^{15}-10^{17}$ ev where they begin to see longer effective mean free paths and to escape more easily from the spiral arms. The energy spectrum is consequently steepened in this range and the abundance of primaries shifted towards heavier nuclei. Above approximately 10^{17} ev the flux from supernovas falls below that of another cosmic-ray population originating in extragalactic sources and taken as diffusing throughout the local supercluster of galaxies. The lifetimes of these primaries are sufficiently long that most of the higher energy particles will have photodecayed into

protons. Parameters in the computations are chosen to fit cosmic-ray observations, to minimize the total cosmic-ray energy required, and to conform reasonably with current astronomical speculation. They result in a flux in the galactic halo almost one order of magnitude less intense than in the spiral arms, and that in the supercluster almost another two orders of magnitude lower. The galactic sources are required to furnish an average of over 10^{48} ergs per year in cosmic-ray energy. (auth)

36184 NOTE ON THE PENETRATION OF ENERGETIC ELECTRONS INTO THE EARTH'S ATMOSPHERE. Manfred H. Rees (Univ. of Colorado, Boulder). Planetary Space Sci., 12: 722-5(July 1964).

The penetration of electrons at several latitudes was calculated including the effect of the earth's magnetic field and extending the energy and height range considered. (D.C.W.)

36185 TIME VARIATION OF COSMIC RAY INTENSITY AT 15° ZENITH AT GULMERG. Tausif H. Naqvi and Niaz Ahmad (Muslim Univ., Aligarh, India). Proc. Indian Sci. Congr., 49: 544-5(1962).

A systemetic study of the daily variation of cosmic ray intensity was performed at Gulmerg at 15° zenith angle. Hourly counts were recorded at 24 azimuth at an interval of 15° at the constant zenith angle. A curve of counting rate versus the hours was plotted. The curve shows a maximum between 12 and 14 hours and two minima obtained in 24 hours, the first between 3 and 4 hours and the second between 19 and 20 hours. The maximum variation from the mean intensity was found to be about 1.5%, which is in accordance with the results of others for vertical intensity. The meteorological data were not considered due to non-availability of the upper air data. (auth)

36186 DETERMINATION OF ATMOSPHERIC CORRECTION FACTORS FOR INTENSITY MEASUREMENTS OF COSMIC RADIATION. M. Zier and R. Knuth. Z. Meteorol., 15: 350-2(Oct.-Dec. 1961). (In German)

On the basis of the measurements made at the Observatory for Ionospheric Research Kuhlungsborn, the influence of the atmospheric effect on the intensity of cosmic radiation was investigated. Two-hour intensity values were obtained with a triple coincidence counter telescope and an ionization chamber, both under an absorber of 12.5 cm Fe. The investigation extended from the beginning of the IGY to the end of 1960. The statistical distribution of the pressure-corrected daily mean value of the cosmic radiation intensity, the barometric effect, the distance effect, annual variation, and the nonlinear correlation for a strong earth pressure fluctuation were determined. (J.S.R.)

36187 INVESTIGATION OF π^0-MESON PRODUCTION AT PARTICLE ENERGIES OF 5×10^{12} TO 10^{13} ev. Kh. P. Babayan, S. I. Brikker, N. L. Grigorov, A. V. Podgurskaya, A. I. Savel'eva, and V. Ya. Shestoperov (Moscow State Univ. and Inst. of Physics, Erevan). Zh. Eksperim. i Teor. Fiz., 47: 379-81(July 1964). (In Russian)

Nuclear emulsions and ionization chambers were used to investigate meson(π^0) production in cosmic particle reactions in graphite at 5×10^{12} to 10^{13} ev. The energy spectra of the gamma radiation were measured. An attempt was made to determine if the mesons(π^0) were produced as a result of the decay of a baryon isobar. (C.E.S.)

36188 A MEASUREMENT OF LOW ENERGY COSMIC RAY PROTONS. Karl Avrum Brunstein. Thesis, Berkeley, Calif., Univ. of California, 1963. 72p.

The results of a high-altitude balloon measurement of the primary proton spectrum at energies between 57 and 77 Mev are reported. Scintillation counters capable of resolving protons from deuterons and tritons were flown at two sites, Sioux Falls, South Dakota, and Churchill, Manitoba. At Churchill the geomagnetic cutoff is well below the energy interval of interest; at Sioux Falls it is well above. It is concluded that the particles observed in both cases were predominantly atmospheric secondaries. A theoretical atmospheric secondary calculation is made which substantiates this conclusion. By a subtraction of the Sioux Falls flux from the Churchill flux, it is found that the primary flux of low energy protons at Churchill is negligible both as compared to the atmospheric secondary contribution and as compared to the primary flux at higher (~ 1 Bev) energies. An upper limit obtained on a statistical basis is considerably lower than that expected based on the values reported for slightly higher energies in an earlier experiment. As a corollary, it is found that the re-entrant albedo at Sioux Falls must also be negligible as compared to the atmospheric secondary contribution at extreme balloon altitudes. This is discussed in relation to a theoretical work on re-entrant albedo which predicts a much larger value. (Dissertation Abstr., 24: No. 12, Pt. I (June 1964))

36189 INTERNATIONAL CONFERENCE ON COSMIC RAYS, JAIPUR, DECEMBER 2-14, 1963, PROCEEDINGS. VOLUME 4. EXTENSIVE AIR SHOWERS. Under the Auspices of the International Union of Pure and Applied Physics and the Department of Atomic Energy, Government of India. R. R. Daniel, P. J. Lavakare, M. G. K. Menon, S. Naranan, N. W. Nerurkar, Yash Pal, and B. V. Sreekantan, eds. Bombay, The Commercial Printing Press Limited, 1964. 332p. Available from Tata Inst. of Fundamental Research, Bombay.

Research activities and measurements on the properties of extensive air showers are discussed. Separate abstracts are prepared for 29 of the 31 papers presented. Abstracts of 2 papers previously appeared in NSA (17: 13073 and 18: 30437). (C.E.S.)

For abstracts of individual papers see: 35893, 36190, 36191, 36192, 36193, 36194, 36195, 36196, 36197, 36198, 36199, 36200, 36201, 36202, 36203, 36204, 36205, 36206, 36207, 36208, 36209, 36210, 36211, 36212, 36213, 36214, 36215, 36216, and 36217.

36190 A GENERAL ACCOUNT OF THE VARIOUS RESEARCH ACTIVITIES AT CHACALTAYA. V. Domingo (Universidad Mayor de San Andrés, La Paz, Bolivia). p.3-8 of "International Conference on Cosmic Rays. Vol. 4." Bombay, Tata Inst. of Fundamental Research, 1964.

Experiments on high energy physics and cosmic radiation studies at Chacaltaya are briefly outlined. (C.E.S.)

36191 EVIDENCE FOR EXTENSIVE AIR SHOWERS WITH EXTREMELY FEW PENETRATING PARTICLES. K. Suga (Universidad Mayor de San Andrés, La Paz, Bolivia), I. Escobar, K. Murakami, V. Domingo, Y. Toyoda, G. Clark, and M. La Pointe. p.9-26 of "International Conference on Cosmic Rays. Vol. 4." Bombay, Tata Inst. of Fundamental Research, 1964.

Preliminary results of an experimental search for extensive air showers generated by primary cosmic gamma radiation with energies greater than 10^{14} ev are reported. The experiment was undertaken with the idea that showers produced by primary photons should contain relatively few mesons (μ) and nuclear particles in comparison with ordinary showers that are initiated by primary nuclei. (C.E.S.)

36192 PRIMARY COSMIC RAYS OF ENERGY 10^{17} TO 10^{20} EV. THE ENERGY SPECTRUM AND ARRIVAL DIRECTIONS. John Linsley (Massachusetts Inst. of Tech., Cambridge). p.77-99 of "International Conference on Cosmic Rays. Vol. 4." Bombay, Tata Inst. of Fundamental Research, 1964.

The arrival directions, shower size spectrum, and the energy spectrum of primary cosmic radiation with energies of 10^{17} to 10^{20} ev are discussed. Evidence is presented that the highest energy particles are protons. (C.E.S.)

36193 EXTENSIVE AIR SHOWERS OF COSMIC RADIATION. G. T. Zatsepin, S. I. Nikolskii, and G. B. Khristiansen. p.100-26 of "International Conference on Cosmic Rays. Vol. 4." Bombay, Tata Inst. of Fundamental Research, 1964.

A brief review is given of the properties of extensive air showers of cosmic radiation. Thirty-four references are cited. (C.E.S.)

36194 EXTENSIVE AIR SHOWERS—STUDIES OF TOKYO GROUP. T. Matano (Tokyo Univ.), I. Miura, M. Nagano, M. Oda, S. Shibata, Y. Tanaka, G. Tanahashi, and H. Hasegawa. p.129-42 of "International Conference on Cosmic Rays. Vol. 4." Bombay, Tata Inst. of Fundamental Research, 1964.

The distribution of mesons (μ), anisotropy, energetic nuclear particles in the core, and inelasticity and nuclear mean free path in extensive air showers are discussed. (C.E.S.)

36195 EXTENSIVE AIR SHOWER STUDIES OF THE T.I.F.R. (BOMBAY) GROUP. B. V. Sreekantan (Tata Inst. of Fundamental Research, Bombay). p.143-67 of "International Conference on Cosmic Rays. Vol. 4." Bombay, Tata Inst. of Fundamental Research, 1964.

The lateral distributions of the electron, meson (μ), and nucleon component of extensive air showers are discussed. Absorption characteristics of mesons (μ) determined by underwater experiments are outlined. (C.E.S.)

36196 CHARACTER OF AIR SHOWERS AT 5,200 m ALTITUDE. I. Escobar (Universidad Mayor de San Andrés, La Paz, Bolivia), V. Domingo, K. Murskami, et al. p.168-72 of "International Conference on Cosmic Rays. Vol. 4." Bombay, Tata Inst. of Fundamental Research, 1964.

A preliminary analysis of the character of air showers observed at an altitude of 5200 m is presented. Lateral distribution, zenith angle distribution, energy flow of the electromagnetic component, the meson (μ) component, and the nuclear component are discussed. (C.E.S.)

36197 A DESCRIPTION OF MODIFIED COMPLEX INSTALLATION FOR INVESTIGATION OF EXTENSIVE AIR SHOWERS AND NEW EXPERIMENTAL DATA OBTAINED BY MEANS OF THIS INSTALLATION. S. N. Vernov (Moscow State Univ.), G. B. Khristiansen, A. T. Abrosimov, et al. p.173-9 of "International Conference on Cosmic Rays. Vol. 4." Bombay, Tata Inst. of Fundamental Research, 1964.

A new installation for the investigation of extensive air showers consisting of scintillation counters, G-M counters, and ionization chambers is briefly described, and experimental data on the electron, photon, and meson (μ) component of extensive air showers are presented. (C.E.S.)

36198 FURTHER DATA ON THE PHOTONIC E.A.S. J. Gawin (Nuclear Research Inst., Lodz, Poland), J. Hibner, A. Zawadzki, and R. Maze. p.180-6 of "International Conference on Cosmic Rays. Vol. 4." Bombay, Tata Inst. of Fundamental Research, 1964.

The results of an analysis of Lodz hodoscope recordings are presented, and it is shown that 0.6% of extensive air showers are photon showers and that such showers contain 11% of penetrating particles. (C.E.S.)

36199 ARRIVAL DIRECTION OF μ-RICH SHOWERS. Y. Sekido and S. Sakakibara (Nagoya Univ., Japan). p.189-93 of "International Conference on Cosmic Rays. Vol. 4." Bombay, Tata Inst. of Fundamental Research, 1964.

An analysis of data on meson (μ)-rich air showers was performed in an attempt to determine the arrival direction in the galaxy. (C.E.S.)

36200 STUDIES ON THE ANISOTROPY OF COSMIC RAYS WITH THE COSMIC RAY TELESCOPES IN NAGOYA. Y. Sekido, I. Kondo, T. Murayama, Y. Kamiya, H. Ueno, S. Mori, H. Okuda, T. Makino, S. Sakakibara, and K. Fujimoto (Nagoya Univ., Japan). p.194-8 of "International Conference on Cosmic Rays. Vol. 4." Bombay, Tata Inst. of Fundamental Research, 1964.

Three studies on the anisotropy of cosmic rays are described: observation of the point source in Orion, observations to detect high-energy γ rays from discrete radio sources, and an attempt to observe the anisotropy of low-density air showers and meson (μ) air showers. (C.E.S.)

36201 ON HIGH ENERGY PHOTONS FROM LOCAL SOURCES. A. E. Chudakov, V. L. Dadykin, V. I. Zatsepin, and N. M. Nesterova (Lebedev Inst. of Physics, Moscow). p.199-204 of "International Conference on Cosmic Rays. Vol. 4." Bombay, Tata Inst. of Fundamental Research, 1964.

Results of a search for cosmic photons of energy ~10^{13} ev from radio sources are presented. (C.E.S.)

36202 CORE STRUCTURE AND PROPERTIES OF EAS. S. Miyake, K. Hinotani, T. Kaneko, and N. Ito (Osaka City Univ.). p.205-8 of "International Conference on Cosmic Rays. Vol. 4." Bombay, Tata Inst. of Fundamental Research, 1964.

Cloud chamber pictures of extensive air showers were analyzed to determine core structure, energy spectra, and attenuation lengths. (C.E.S.)

36203 DEVELOPMENT OF VERTICAL EXTENSIVE AIR SHOWERS IN THE UPPER PART OF THE ATMOSPHERE. R. A. Antonov, Yu. A. Smorodin, and Z. I. Tulinova (Lebedev Inst. of Physics, Moscow and Moscow State Univ.). p.209-13 of "International Conference on Cosmic Rays. Vol. 4." Bombay, Tata Inst. of Fundamental Research, 1964.

Extensive air showers were studied at atmospheric depths of 455, 311, and 197 g/cm^2 with hodoscope counters and ionization chambers. Energy of the electron-photon cascades was recorded. Differential density spectra, lateral distributions, cascade parameters, the flux of vertical showers, and the altitude variation of the extensive air showers are discussed. (C.E.S.)

36204 THE ALTITUDE VARIATION OF AIR SHOWERS. K. Kamata, K. Murakami, and S. Kawasaki (Inst. of Physical and Chemical Research, Tokyo). p.214-18 of "International Conference on Cosmic Rays. Vol. 4." Bombay, Tata Inst. of Fundamental Research, 1964.

Extensive air showers were observed at altitudes of 5200 and 2770 m, and at sea level. The age distribution of the showers, the distribution of the production height of the showers, and the relation between the depth of the shower maximum and primary energy are discussed. (C.E.S.)

36205 NUCLEAR-ACTIVE PARTICLES IN SHOWERS WITH DIFFERENT NUMBER OF PARTICLES. T. V. Danilova and S. I. Nikolskii. p.221-6 of "International Conference on Cosmic Rays. Vol. 4." Bombay, Tata Inst. of Fundamental Research, 1964.

The results of measurements of the total number of nuclear active particles in showers of sizes $N = 3 \times 10^3$ to 3×10^7 at the altitude of 3330 m above sea level are reported. (C.E.S.)

36206 STUDIES ON EXTENSIVE AIR SHOWERS (10^5–10^7) AT MOUNTAIN ALTITUDE (800 g cm^{-2}). B. K. Chatterjee, G. T. Murthy, S. Naranan, B. V. Streekantan, and M. V. Srinivasa Rao (Tata Inst. of Fundamental Research, Bombay). p.227-43 of "International Conference on Cosmic Rays. Vol. 4." Bombay, Tata Inst. of Fundamental Research, 1964.

Results based on an analysis of extensive air showers with sizes ranging from 10^5 to 10^7 are presented. The lateral distributions of electron, neutron, and meson (μ) components and their mutual correlations, the total number of particles and their fluctuations, size spectra, attenuation lengths, and meson (μ) energy spectra are discussed. (C.E.S.)

36207 ANISOTROPY OF THE MUON RICH EAS. T. Matano (Tokyo Univ.), I. Miura, M. Nagano, M. Oda, S. Shibata, Y. Tanaka, G. Tanahashi, and H. Hasegawa. p.248-53 of "International Conference on Cosmic Rays. Vol. 4." Bombay, Tata Inst. of Fundamental Research, 1964.

The structure of air showers was investigated on the basis of the meson (μ) component, and the arrival direction of meson (μ)-rich extensive air showers was studied. (C.E.S.)

36208 N-PARTICLES IN EXTENSIVE AIR SHOWERS. T. Kameda, Y. Toyoda, and T. Maeda (Kobe Univ., Japan). p.254-7 of "International Conference on Cosmic Rays. Vol. 4." Bombay, Tata Inst. of Fundamental Research, 1964.

An investigation of high-energy nuclear active particles in extensive air showers by means of a cloud chamber is discussed. A marked anisotropy was found for the arrival directions of extensive air showers that had one or more nuclear active particle of energy greater than 10^{11} ev. Results on the anisotropy and the related analysis are reported. (C.E.S.)

36209 ARRIVAL DIRECTIONS OF LARGE EAS. B. R. Dennis and J. G. Wilson (Univ. of Leeds, Eng.). p.258-60 of "International Conference on Cosmic Rays. Vol. 4." Bombay, Tata Inst. of Fundamental Research, 1964.

The zenith angle, azimuth, and sidereal time of arrival of about 6000 showers were recorded. Possible anisotropies in arrival directions were examined in terms of galactic features. An analysis of the data failed to show any indication of directions of high or low primary intensity. (C.E.S.)

36210 MULTIPLE MUON EVENTS IN AIR SHOWERS AT SEA LEVEL. R. G. Bingham and E. W. Kellermann (Univ. of Leeds, Eng.). p.261-3 of "International Conference on Cosmic Rays. Vol. 4." Bombay, Tata Inst. of Fundamental Research, 1964.

The observation of 19 meson (μ) double events in air showers at sea levels is reported. The mesons (μ) ran parallel within 2° at a rate of (0.009 ± 0.002) hr^{-1}. The separation of the trajectories varied between 10 and 30 cm. The average density of air showers accompanying the double events was 170 m^{-2}, and the lower limit of the mesons (μ) was estimated to be greater than 6 Bev. (C.E.S.)

36211 THE DENSITY SPECTRUM OF EXTENSIVE AIR SHOWERS AT VERY LARGE DENSITIES. T. Gemesy, A. Somogyi, and G. Valas (Central Research Inst. of Physics, Budapest). p.267-72 of "International Conference on Cosmic Rays. Vol. 4." Bombay, Tata Inst. of Fundamental Research, 1964.

A cloud chamber technique and a method of maximum likelihood were used to determine the exponent of the density spectrum of extensive air showers. (C.E.S.)

36212 STUDY OF THE PROPERTIES OF THE PENETRATING COMPONENT OF EAS AT THE DEPTH OF 200 m.w.e. T. T. Barnaveli, M. F. Bibilashvili, G. A. Grubelashvili, A. K. Javrishvili, R. E. Kazarov, R. V. Kuridze, and I. V. Khaldeeva (Inst. of Physics, Academy of Sciences, Georgian SSR). p.273-6 of "International Conference on Cosmic Rays. Vol. 4" Bombay, Tata Inst. of Fundamental Research, 1964.

Hodoscopic detectors were placed at the depth of 2 mwe underground to obtain data on the mean characteristics and flux irregularities in the meson (μ) component of extensive air showers. The spatial distribution and total number of mesons (μ) and the exponent of the density spectrum of extensive air showers were determined. (C.E.S.)

36213 ABSORPTION CHARACTERISTICS OF MUONS IN EXTENSIVE AIR SHOWERS. K. Hinotani, S. Miyake, and M. V. Srinivasa Rao (Tata Inst. of Fundamental Research, Bombay). p.277-83 of "International Conference on Cosmic Rays. Vol. 4." Bombay, Tata Inst. of Fundamental Research, 1964.

The absorption mean free path for mesons (μ) of energies 1 and 2 Bev was determined by means of scintillation detectors placed at various underwater depths. (C.E.S.)

36214 THE FLUCTUATION OF DENSITY OF MUONS IN EXTENSIVE AIR SHOWERS. H. Hasegawa, T. Matano, I. Miura, and S. Shibata (Tokyo Univ.). p.284-9 of "International Conference on Cosmic Rays. Vol. 4." Bombay, Tata Inst. of Fundamental Research, 1964.

Results of the observed and calculated frequency of events with mesons (μ) ($\geq$1 Bev) in which the minimum separations of adjacent mesons (μ) were less than 22 and 32 cm are reported. (C.E.S.)

36215 PRODUCTION IN THE ATMOSPHERE OF EAS CONTAINING VERY FEW MUONS. T. Matano and V. S. Narasimham (Tata Inst. of Fundamental Research, Bombay). p.290-4 of "International Conference on Cosmic Rays. Vol. 4." Bombay, Tata Inst. of Fundamental Research, 1964.

The types of primary proton interactions in the atmosphere that can lead to extensive air showers containing very few mesons (μ) are considered. (C.E.S.)

36216 AIR SHOWER FLUCTUATIONS. John Linsley (Massachusetts Inst. of Tech., Cambridge). p.295-305 of "International Conference on Cosmic Rays. Vol. 4." Bombay, Tata Inst. of Fundamental Research, 1964.

The problem of air shower fluctuations is investigated by calculating the probability of observing a shower within a given size interval at a given altitude produced by a primary particle of a given species with a given energy. (C.E.S.)

36217 TWO LARGE AIR SHOWER EXPERIMENTS. C. B. A. McCusker, H. D. Rathgeber, and M. M. Winn

(Univ. of Sydney). p.306-9 of "International Conference on Cosmic Rays. Vol. 4." Bombay, Tata Inst. of Fundamental Research, 1964.

The experimental apparatus and procedures for determining cosmic radiation energy and mass spectra and apparent isotropy are described. (C.E.S.)

36218 COSMIC RAYS. T. E. Cranshaw. Oxford Library of The Physical Sciences. New York, Oxford University Press, 1963. 132p. $2.90.

The present state of knowledge in cosmic ray physics is reviewed. Included are chapters describing the nature of the primary beam, the theories of the origin of cosmic radiation, the extensive air showers, and the geomagnetic effects and time variations. (R.E.U.)

36219 PRODUCTION OF NEUTRONS BY COSMIC RADIATION. Serge A. Korff (New York Univ., New York). p.427-40 of "The Natural Radiation Environment." Chicago, University of Chicago Press, 1964.

The four principal properties of primary cosmic rays are reviewed briefly. The neutron equilibrium in the atmosphere is considered, and the production and disappearance processes are described. If the measured neutron production is plotted against depth in the atmosphere, a maximum (Pfotzer maximum) is obtained at ~0.1 atm below the top. Neutron measurements above the atmosphere are discussed. It is stated that the neutrons produced in a space ship will probably not exceed the Pfotzer maximum. (D.L.C.)

36220 PROGRESS REPORT ON FLUX AND SPECTRUM MEASUREMENTS OF THE COSMIC-RAY NEUTRON BACKGROUND. Jacob Kastner, B. G. Oltman, and L. D. Marinelli (Argonne National Lab., Ill.). p.441-8 of "The Natural Radiation Environment." Chicago, University of Chicago Press, 1964.

The calibration of the twin scintillator and the testing of pulse-shape discrimination circuits are described. Some data are presented on the fast-neutron environmental background. (D.L.C.)

Criticality Studies

Refer also to abstracts 36778 and 36780.

36221 (LAMS-1969) SIMPLE CRITICAL MASS CALCULATIONS. Gordon E. Hansen (Los Alamos Scientific Lab., N. Mex.). Oct. 1955. Contract [W-7405-eng-36]. 21p.

A simple empirical equation that should yield critical mass values of homogeneous, partially moderated, unreflected spherical assemblies with an accuracy of a factor two is given, and critical mass estimates are obtained from the equation for Oy–C–H and Oy–W–CH_2 systems. (auth)

Direct Energy Conversion

Refer also to abstract 35929.

36222 (AD-431610) NOVEL POWER SOURCES FOR SURVIVAL SHELTERS. Francis W. Lauck and Vern D. Overbye (Smith (A. O.) Corp. Long Range Research Lab., Milwaukee). Mar. 1963. Contract OCD-OS-62-243. 147p.

Systems using various energy-conversion devices for the generation of power are reviewed. Both conventional and novel conversion devices are considered; included are thermionic cells, fuel cells, thermoelectric elements, MHD devices, solar cells, internal-combustion devices, etc. Heat rejection from the shelter is discussed. (R.E.U.)

36223 (AD-434574) INVESTIGATION OF NON-EQUILIBRIUM IONIZATION FOR MHD ENERGY CONVERSION. Quarterly Report No. 8, December 15, 1963–March 15, 1964. B. Hoffman (General Electric Co. Missile and Space Div., Valley Forge Space Technology Center, King of Prussia, Penna.). Contract AF33(657)-8298. 20p.

A theoretical and applied research program directed toward prolonging the lifetime of magnetohydrodynamic (MHD) energy converters to the range 1000 to 2000°K is described. The process of interest is the use of the self-induced electric field in the MHD generator for electrical breakdown of appropriate working fluids. Work is directed toward the use of potassium for Rankine (vapor) cycles. (auth)

36224 (AD-434908) RESEARCH STUDIES ON THERMIONIC CONVERTERS, EMITTER SHELL PHASE. Report No. 2. Second Quarterly Technical Report, October 1, 1963–December 31, 1963. G. Y. Eastman (Radio Corp. of America. Special Electronic Components Div., Lancaster, Penna.). Jan. 1964. Contract DA-36-039-AMC-03197 (E). 36p.

This study concentrated on the permation evaluation of sample materials and the design of the converter. Sample materials, after a preliminary examination, were evaluated for permeation. The mathematics of the investigation were reviewed and refined to assure accurate analyses. Testing techniques were developed. A control sample of molybdenum was evaluated to verify permeation rates. The sensitivity of the equipment was established. Hydrogen permeation rates for four sample materials were determined, and, although sample materials were determined, and, although hydrogen permeation does take place, it is at levels that can be controlled by known sorption and gettering processes. A converter for use with fossil fuel was developed, employing materials compatible with cesium and designed to permit the substitution of the emitter barrier with material determined optimum by the evaluation program. (auth)

36225 (AD-600365) THERMOELECTRIC POWER MODULES. Report No. 4. Final Report, January 2–December 31, 1963. Hans P. Van Heyst and Timothy M. Cunningham (Radio Corp. of America. Special Electronic Components Div., Harrison, N. J.). Jan. 31, 1964. Contract DA36-039-AMC-00110(E). 120p.

Silicon–germanium thermoelectric power modules were designed and developed. Modules operated satisfactorily under steady-state and thermal cycling conditions for several thousand hours. These modules were directly exposed to the exhaust gases of various fossil fuels and a number were also tested for shock and vibration. A thermoelectric power module was developed, which can be used in the design of thermoelectric power generators. Considerations in terms of electrical, mechanical, and thermal design requirements indicated that an effective element length of 2.03 centimeters incorporated in a six-couple module could be used effectively in the "building block" design concept. The modules, when operated at a hot junction temperature of 840°C and a cold junction temperature of 238°C, would deliver 4.2 watts at 0.91 volts for matched load conditions. A device efficiency of 6% was shown by analytical computations and by laboratory measurements. Based on a statistical analyses of the data accumulated, the modules have a reliability of at least 91.5% at a minimum life expectancy of 3000 hours. The modules exhibited a minimum mean-time-before-failure of at least 22,900 hours at a 50% confidence level. Some effort was spent in obtaining heat transfer characteristics of heat exchangers under free and forced convection conditions. The electrical characteristics of the

modules were evaluated, and an arrangement of either series or series-parallel was determined to satisfy a wide range of voltage and power requirements. Making use of the developed module design, conceptual 100-watt thermoelectric generator designs are discussed. (auth)

36226 (AD-601255) LONG-LIFE CLOSED-LOOP MHD RESEARCH AND DEVELOPMENT UNIT. Quarterly Technical Progress Report No. 9, March 1, 1964–May 31, 1964. R. L. Hundstad, F. A. Holmes, S. Way, and M. G. Fey (Westinghouse Electric Corp., Pittsburgh). May 28, 1964. Contract AF33(657)-8311. 35p.

The second test of the closed loop verified the reliability and versatility of the peripheral equipment and measuring instruments. Many improvements were made in the loop after the first test. The second test was not wholly successful. Details of the second test are presented along with a description of the status of the ceramic-lined end returns. Estimated loop performance calculations have been made for two additional temperatures, thereby giving a more complete theoretical picture of its capabilities than was previously possessed. (auth)

36227 (AD-603235) RESEARCH ON NEW CONCEPTS IN ENERGY CONVERSION. Quarterly Technical Progress Report No. 3, March 1, 1964–May 31, 1964. W. D. Jackson, G. A. Brown, J. L. Kerrebrock, and E. N. Carabateas (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics). June 15, 1964. Contract AF33(615)-1083. 22p.

Studies on the liquid-metal MHD, alkali-metal MHD, and cesium thermionic concepts for direct energy conversion are reported. An additional study on the electric conductivity of wet and dry K vapor is presented. (T.F.H.)

36228 (GEST-2033) RESEARCH PROGRAM FOR THE LONG TERM TESTING OF CYLINDRICAL DIODES AND THE RADIATION OF FUEL AND INSULATOR. Quarterly Progress Report, December 18, 1963–March 17, 1964. (General Electric Co. Vallecitos Atomic Lab., Pleasanton, Calif.). Contract NAS-3-2544. 61p.

The testing of nuclear-thermionic converter elements is described. The performance of W–Re clad UO_2 and UO_2–W as fuel elements for nuclear-thermionic cells is reviewed. Neutron-irradiation effects on alumina insulators for these cells are studied. (T.F.H.)

36229 (NASA-TN-D-2429) ANALYTICAL INVESTIGATION OF THE RADIATOR AREA CHARACTERISTICS OF OUT-OF-PILE THERMIONIC GAS CYCLE SPACE POWER SYSTEMS. Michael R. Vanco and Arthur J. Glassman (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). Aug. 1964. 36p.

The radiator area potential of out-of-pile thermionic space power systems using an inert gas as the heat-transfer medium was assessed by studying the radiator area characteristics of several candidate cycles and comparing the radiator area requirements with those for a turboelectric Brayton cycle. Split Radiator, Two Loop, and Turbineless thermionic gas cycles were considered. This study was primarily a thermodynamic cycle analysis, with thermionic converter efficiency being treated both parametrically and through the use of experimental data. (auth)

36230 (NP-14101) THE DEVELOPMENT OF A LOW-TEMPERATURE CYLINDRICAL THERMIONIC GENERATOR. First Quarterly Technical Report, June 1964. (Radio Corp. of America. Special Electronic Components and Devices Div., Lancaster, Penna.). Contract AF33(615)-1547. 38p.

The development of a low-temperature cylindrical thermionic generator is described. Objectives include: evaluation of samples; design and evaluation of modules; investigation of low-work-function collectors; investigation of high-temperature collector operation; and investigation of the effects of inert gas injection. Work covers the analysis of failures, life testing to more than 4300 hours, and design for a module. A control standard converter was fabricated for the investigation of low-work-function collectors. One sample collector material was evaluated. A converter design was modified for high-temperature operation, and one converter employing a molybdenum emitter and molybdenum collector was fabricated. (auth)

36231 (USAELRDL-TR-2431) PERMEATION OF HYDROGEN THROUGH METALS IN THERMIONIC-CONVERTER APPLICATIONS. John E. Creedon (Army Electronics Research and Development Lab., Fort Monmouth, N. J.). Jan. 1964. 19p. (AD-434873)

Permeation of hydrogen through the emitter surface of a thermionic converter is discussed. Approaches to eliminating a pressure buildup inside the converter are examined, and it is shown that a nickel window could be used to maintain a relatively low partial pressure of hydrogen. (auth)

36232 (USAELRDL-TR-2434) MECHANISM OF CESIUM IONIZATION. J. E. Creedon and S. Schneider (Army Electronics Research and Development Lab., Fort Monmouth, N. Y.). Feb. 1964. 2p. (AD-434814)

A theoretical model for the ionization of cesium vapor in the presence of a hot body and in the absence of an applied voltage sufficient to accelerate electrons to the ionization potential of cesium was formulated. The model is predicated on an inelastic two-body collision mechanism involving cesium atoms excited by light radiated from a hot body. (auth)

36233 ELECTROGASDYNAMIC POWER GENERATION. Bernard Kahn and Meredith C. Gourdine (Curtiss-Wright Corp., Wood-Ridge, N. J.). AIAA (Am. Inst. Aeron. Astronaut.) J., 2: 1423-7(Aug. 1964).

A slender-channel model was analyzed, and the feasibility of the model was investigated experimentally. The results prompted experimental and theoretical investigations of a segmented slender-channel model. Good agreement between the experimental results and theoretical predictions for the segmented channel was obtained. The results indicate that colloidal ions rather than molecular ions should be used in such systems. (D.C.W.)

36234 SOME DATA ON CAESIUM THERMIONIC CONVERTER WITH MERCURY AND XENON MIXTURES. Eugen Badareu, Iovitzu Popescu, and Octavian Zamfir (Inst. of Physics, Bucharest). J. Electron. Control (1), 16: 653-8(June 1964).

The influence of mercury and xenon on the cesium diode current was experimentally investigated. In the case of cesium–mercury mixture the Penning effect was stimulated by irradiation or acceleration of electrons; this leads, under some conditions, to a large current amplification. (auth)

36235 DIRECT CONVERSION. 1962 Pacific Energy Conversion Conference Proceedings. New York, American Institute of Electrical Engineers, 1962. 216p. $5.00.

Separate abstracts were prepared for eight of the thirty papers included. Other papers deal with fuel cells, photo-

voltaic systems, storage batteries, and thermoelectric conversion. (D.C.W.)

For abstracts of individual papers see: 36236, 36237, 36238, 36239, 36240, 36241, 36242, and 36846.

36236 THERMIONIC CONVERSION. G. N. Hatsopoulos and E. N. Carabateas (Massachusetts Inst. of Tech., Cambridge). Paper 3 of "Direct Conversion." New York, American Institute of Electrical Engineers, 1962. 12p.

The principles of thermionic convertors are briefly reviewed, together with some developments in such convertors. (D.C.W.)

36237 THERMIONIC CONVERTER RESEARCH. H. F. Webster (General Electric Research Lab., Schenectady, N. Y.). Paper 4 of "Direct Conversion." New York, American Institute of Electrical Engineers, 1962. 6p.

The work being done at the General Electric on thermionic energy conversion is reviewed, including research on the work function of various materials and the physics of low-voltage cesium plasmas as well as operating thermionic converters. The results of measurements of the effects of electrode temperatures on operating characteristics of converters are included. (auth)

36238 IN-REACTOR TESTS OF PLASMA DIODES. H. Malcolm Ogle (Applied Systems Corp., Palo Alto, Calif.). Paper 5 of "Direct Conversion." New York, American Institute of Electrical Engineers, 1962. 8p.

A series of laboratory and in-pile tests performed on cesium plasma diodes with unclad UC–ZrC and refractory-metal-clad UO_2 cathodes are summarized. (D.C.W.)

36239 CESIUM PLASMA DIODES UTILIZING FISSION ENERGY AS AN EMITTER HEAT SOURCE. Walter H. Reichelt (Los Alamos Scientific Lab., N. Mex.). Paper 6 of "Direct Conversion." New York, American Institute of Electrical Engineers, 1962. 4p.

Cesium plasma diodes using fission energy as an emitter heat source were investigated. The maximum short circuit current density is of the order of 26 amps/cm^2 from the UC:ZrC emitters employed. Power densities of 17 w/cm^2 were measured. Comparison with the results of electrically heated diodes is good. (auth)

36240 MHD POWER GENERATION. R. J. Rosa (Avco-Everett Research Lab., Everett, Mass.). Paper 29 of "Direct Conversion." New York, American Institute of Electrical Engineers, 1962. 12p.

The principles of MHD power generation are reviewed, including basic electrical properties of gases, major loss mechanisms and overall design considerations. Possible commercial and space applications and the present status of MHD generators are outlined. (auth)

36241 MAGNETOHYDRODYNAMIC A-C POWER GENERATION. H. H. Woodson (Massachusetts Inst. of Tech., Cambridge). Paper 30 of "Direct Conversion." New York, American Institute of Electrical Engineers, 1962. 17p.

Four possible MHD systems for a-c power generation are briefly described, and approximate analyses of the four systems are outlined. (D.C.W.)

36242 REDUCTION OF OPERATING TEMPERATURE OR GENERATOR LENGTH IN MHD POWER PLANTS. S. Way (Westinghouse Electric Corp., Pittsburgh). Paper 31 of "Direct Conversion." New York, American Institute of Electrical Engineers, 1962. 7p.

The relations between length, cycle efficiency, and inlet temperature are summarized; and the use of cesium (pollucite ore) seeding, a reheat cycle, a superconducting magnet, or an exhaust blower to reduce either length or temperature without adversely affecting efficiency is briefly discussed. (D.C.W.)

36243 RECENT DEVELOPMENTS IN MHD POWER GENERATION AT THE AVCO-EVERETT RESEARCH LABORATORY. T. R. Brogan (AVCO-Everett Research Lab., Everett, Mass.). p.571-82 of "Gas Discharges and the Electricity Supply Industry." London, Butterworths, 1962.

A general review of work in the field of MHD power generation during the past year is presented. The review includes the areas of conceptual plant design, electric properties of gases, generator fluid mechanics and performance, field coil designs, and long duration testing. In the area of gas properties, the experimentally determined conductivity of seeded combustion products is in good agreement with predicted values in the temperature range between 2,300 and 3,000°K. The study of generator fluid mechanics has continued during the past year using the Mark II combustion generator. Successful operation at Hall coefficients up to two was achieved. Actual and theoretical performances of the Mark II generator are compared. The discovery of high field strength superconducting alloys has important implications for MHD power generation, as well as for many other MHD devices. There is a brief description of these coils as applied to MHD generators, together with an assessment of the economic possibilities they present for use in a power plant. (auth)

36244 MHD RESEARCH IN THE CENTRAL ELECTRICITY GENERATING BOARD. J. K. Wright (Central Electricity Generating Board, Leatherhead, Surrey, Eng.). p.583-95 of "Gas Discharges and the Electricity Supply Industry." London, Butterworths, 1962.

The use of a MHD generator as a thermodynamic topper to increase the thermodynamic efficiency of the large-scale generation of electric power is discussed. From the results obtained to date it seems that a d-c generator, using combustion products as the working fluid, is the most practicable system. It is believed that the fuel will be burned in preheated but not enriched air. Although some progress was made with the problem of permanent emitting electrodes, this problem, together with that of wall materials, remains the major obstacle to the practical exploitation of MHD. (auth)

36245 CLOSED-CYCLE MAGNETO-PLASMADYNAMIC ELECTRICAL POWER GENERATION. B. C. Lindley (C. A. Parsons and Co. Ltd., Newcastle-upon-Tyne, Eng.). p.596-619 of "Gas Discharges and the Electricity Supply Industry." London, Butterworths, 1962.

Utilizing supercritical steam conditions and embodying cycle refinements and advances in alternator design, a steam turbo-alternator plant of perhaps 2,000 Mw output per unit, with fossil fuel or nuclear fission energy sources, will be coming into service within one to two decades. Such a plant may represent the ultimate in capital, fuel, and operating costs, and may achieve a thermal efficiency of 45 per cent. Further advances can be achieved through energy conversion techniques that do not require highly stressed rotating parts. The magnetoplasmadynamic (MPD) system falls into this category and may best be employed in conjunction with a steam cycle, resulting in overall efficiencies approaching 60 per cent. Power cycle studies and power generation experiments so far conducted were mainly related to the extraction of energy from combustion plasma flows; consideration is given to some of the factors involved

in closed-cycle nuclear-MPD-steam plant suitable for large scale base-load electric power generation. (auth)

36246 RESEARCH ON THE OPTIMUM PROFILES AND BEST OPERATING CONDITIONS FOR LINEAR MAGNETOHYDRODYNAMIC GENERATORS. J. Pericart (Electricite de France, Paris). p.620-8 of "Gas Discharges and the Electricity Supply Industry." London, Butterworths, 1962.

The fundamental magnetohydrodynamic equations are reviewed. Characteristic efficiency parameters are defined from the economic point of view. The results of digital computations are given for two duct configurations (constant cross section and constant velocity). It appears that the different parameters cannot be optimized simultaneously. (auth)

36247 SOME ASPECTS OF HIGH TEMPERATURE PLASMAS PRODUCED BY CHEMICAL REACTIONS IN FLAMES WITH REFERENCE TO MAGNETOHYDRODYNAMIC POWER GENERATION. T. M. Sugden (Cambridge Univ., Eng.). p.629-36 of "Gas Discharges and the Electricity Supply Industry." London, Butterworths, 1962.

A general review is given of the various types of chemical reaction which can lead to ionization in flames of hydrocarbon fuels with air or oxygen. Three kinds of phenomenon are distinguished—the natural ionization produced in the course of ordinary flame reactions, the ionization of metallic additives of relatively high ionization potential by electron transfer reactions from the natural ions, and finally the ionization of metallic additives of relatively low ionization potential. The last type is unrelated to the natural ionization. Possible methods of augmentation of this last kind of ionization are considered, in particular the addition of halogens under carefully selected conditions. Of the three types of ionization considered, the first two are essentially chemi-ionization effects, bearing little relation to the conditions of thermodynamic equilibrium in the flame, while the third is largely a thermal phenomenon—i.e., it is very closely related to the conditions of thermodynamic equilibrium. (auth)

36248 THE PHYSICAL BEHAVIOUR OF THREE MAGNETOHYDRODYNAMIC GENERATOR CONFIGURATIONS. Z. Croitoru (Electricite de France, Paris). p.637-47 of "Gas Discharges and the Electricity Supply Industry." London, Butterworths, 1962.

The conductivity tensor of an ionized gas subjected to a magnetic field is reviewed and applied to magnetohydrodynamic generators. The three configurations under consideration are distinguished by the characteristic directions of the electric field or of the current and by the different roles of the electrons and positive ions. From the practical point of view, the performances of the three types of generator differ considerably according to the importance of the Hall effect. (auth)

36249 DIRECT ENERGY CONVERSION WITH AN IONIZED VAPOUR STREAM. S. Klein (CEN, Saclay, France). p.648-53 of "Gas Discharges and the Electricity Supply Industry." London, Butterworths, 1962.

Previous experiments showed that it is possible to obtain an electromotive force of the order of few volts when two metallic electrodes are inserted into an ionized condensable vapor such as mercury, cesium, or water. This emf may be obtained provided that one of the electrodes is kept at a temperature lower, and the other electrode at a temperature higher, than the condensation temperature of the vapor. The colder electrode always becomes positive with respect to the warmer. These experiments seemed to indicate that the main mechanism for the appearance of this emf was associated with the thin gaseous layer which was found to surround the cold electrode. New experiments which contribute to a better understanding of the physical properties of this gaseous layer are described. Within this layer the electron and ion temperature are considerably decreased, the gas density increases, and condensation droplets make their appearance. The improvements in converter performance, due to these recent experimental results, are described. (auth)

Elementary Particles and Radiations

36250 (NP-14203) O VOZMOZHNYKH TIPAKH ELEMENTARNYKH CHASTITS. (Possible Types of Elementary Particles). L. B. Okun (Akademiya Nauk S.S.S.R. Institut Teoreticheskoi i Eksperimental'noĭ Fiziki, Moscow and U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii). 1964. 11p.

The possibility of the existence of elementary particles with unusual combinations of the values of baryonic and leptonic charges and spin, both possessing and not possessing strong interaction, is discussed. (auth)

36251 (PAN-475/VII) FIVE-PION ISOSPIN WAVE FUNCTIONS. M. Grynberg and Z. Koba (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Nov. 1963. 9p.

A complete orthonormal set of isospin wave functions for five pions, which possess definite values of the total isospin – T and its third component – T_3, as well as definite symmetry, is given. (auth)

36252 (TID-19540) PARTIALLY CONSERVED CURRENT APPROACH TO Kl4 DECAY. B. Sakita, M. Kato, and E. McCliment (Wisconsin. Univ., Madison). Sept. 26, 1963. Contract [AT(11-1)-30]. 15p.

An estimate of the rate for the decay $K^+ \rightarrow \pi^+ + \pi^- + e^+ + \nu$ is given based on the partially conserved current hypothesis for the $\Delta S = \Delta Q$ strangeness-changing axial vector current. In this manner a relation between the Kl4 and Kl2 decay amplitudes and the $K\overline{K} \rightarrow \pi\pi$ reaction amplitude is obtained. The value for the ratio $W(Ke4)/W(K\mu4) = 9.1$, which is quite insensitive to the $K\overline{K} \rightarrow \pi\pi$ amplitude, is obtained. For the actual decay rate, an estimate of the $K\overline{K} \rightarrow \pi\pi$ amplitude is made by relating it to the $\pi\pi$ scattering amplitude through unitary symmetry. The numerical value of the ratio $W(Ke4)/W(K\mu2)$ thus obtained is 7×10^{-4}, which seems to be approximately an order of magnitude larger than the experimental value of 0.4×10^{-4} if we take $a = 1.3$ for the s-wave $\pi\pi$ scattering length. (auth)

36253 (UCRL-7425) NEUTRINO THEORY OF PHOTONS. W. A. Perkins (California. Univ., Livermore. Lawrence Radiation Lab.). Aug. 20, 1963. Contract W-7405-eng-48. 25p.

For the case of zero mass, the Dirac equation splits into two independent pairs of equations. The usual procedure has been to take only one pair. By taking both pairs (i.e., assuming that both types of two-component neutrinos exist), a neutrino theory of photons is formed. A photon is then composed of the appropriate combination of neutrino and antineutrino. The photon field is constructed by describing the annihilation and creation of photons in terms of neutrino and antineutrino processes. The electric and magnetic fields so formed are shown to satisfy Maxwell's equations and the well-known commutation relations. Some experimental implications of the theory are discussed. (auth)

36254 (UCRL-11291) STUDY OF THE REACTION $K^- + p \rightarrow \Lambda + \pi^+ + \pi^-$ FROM 1.2 TO 1.7 Bev/c (thesis). Darrell O. Huwe (California. Univ., Berkeley. Lawrence Radiation Lab.). July 9, 1964. Contract W-7405-eng-48. 157p.

A sample of events of the reaction $K^- + p \rightarrow \Lambda + \pi^+ + \pi^-$ was selected from an exposure of the 72-inch hydrogen bubble chamber to a separated K^- beam of the Bevatron. Laboratory momentum of the K^- in this sample was set at six values, ranging from 1.22 to 1.69 Bev/c. A sample at lower energy was also used in part of the analysis. Dalitz plots and effective-mass distributions show that the Λ-π resonance, Y_1^* (1385), is the dominant final state; the π-π resonance, ρ (750), also important, has a maximum cross section at 1.5 Bev/c; and Y_1^* (1660) is produced weakly. A peak in the π-π distribution can be interpreted as the electromagnetic decay, $\omega \rightarrow \pi^+\pi^-$, but possible interference of this state with the ρ^0 precludes a unique assignment of the branching ratio of this mode to the three-pion mode. A lower limit of $(0.6 \pm 0.2)\%$ is set for this ratio, and thus the existence of the mode is established. There is also evidence of an enhancement in the π-π spectrum at very low energy. The angular correlations of the decay products of the Y_1^* (1385) were studied and it was determined that the spin-parity of this resonance is $P_{3/2}$, with a slight chance that it is $D_{3/2}$. With this spin-parity assignment, all of the observed properties of the Y_1^* (1385) are consistent with assignment to a decuplet in the eightfold-way theory. There is evidence of initiation of peripheral production of Y_1^* (1385) above 1.5 Bev/c, but this process is not yet dominant at 1.7 Bev/c. (auth)

36255 (UCRL-11360) ASSOCIATED PRODUCTION FROM 1.5 TO 2.4 Bev/c (thesis). Joseph Adam Schwartz (California. Univ., Berkeley. Lawrence Radiation Lab.). June 29, 1964. Contract W-7405-eng-48. 57p.

The two-body final states $\pi p \rightarrow \Sigma^0 K^0$, $\pi p \rightarrow \Sigma^- K^+$, and $\pi p \rightarrow \Lambda K^0$ were studied in the 72-inch hydrogen bubble chamber. The cross sections decrease uniformly from 1.5 to 2.4 Bev/c with no evidence for an enhancement from any of the nucleon isobars located in this energy range. The average cross sections are $\sigma(\Sigma^0 K^0) = 115\ \mu b$, $\sigma(\Sigma^- K^+) = 70\ \mu b$, and $\sigma(\Lambda K) = 180\ \mu b$. The $\Sigma^- K^+$ angular distributions are well described by s and p waves only; $\Sigma^0 K^0$ and ΛK^0 each show evidence for higher partial waves. A simple K^*-exchange model fits the data poorly for both $\Sigma^0 K^0$ and ΛK^0. There is evidence for the coupling of $N^*_{1/2}$ (2190) to the ΛK channel but no definite spin assignment can be made, although $G_{1/2}$ is somewhat favored over a $J = {}^3/_2$ assignment. The backward peak in the ΛK angular distribution can be fitted with a form $d\sigma/d\Omega = \sigma_0 e^{At}$ with $A \approx 7\ (\text{Bev/c})^{-1}$. The values of A obtained in this way are suggestive of the logarithmic shrinking predicted by the Regge-pole analyses of high-energy backward (diffraction) scattering. (auth)

36256 DECAY OF THE INTERMEDIATE BOSON. Jean Nuyts (CERN, Geneva). Bull. Classe Sci., Acad. Roy. Belg. (5), 49: 708-29(1963). (In French)

A study of the more interesting decay modes of the intermediate boson is presented. These are considered not only phenomenologically, but some dynamical hypotheses are made when they are useful. (auth)

36257 "TOTAL" PROTON-PROTON CROSS SECTIONS. R. Goloskie (Worcester Polytechnic Inst., Mass. and Harvard Univ., Cambridge, Mass.) and J. N. Palmieri. Nucl. Phys., 55: 463-70(July 1964).

The cross section for the scattering of protons by protons into the angular range of 6 to 84° (laboratory system) was measured for several proton energies using a good-geometry absorption technique. The results are tabulated. (auth)

36258 PARTICLE-PARTICLE AND PARTICLE-ANTIPARTICLE INTERACTIONS. Suraj N. Gupta (Wayne State Univ., Detroit). Nucl. Phys., 57: 19-28(Aug. 1964).

A general method for the derivation of the particle-particle and particle-antiparticle interaction operators by methods of field theory is given, and it is applied to the electromagnetic electron-electron and electron-positron interactions as well as to the pionic proton-proton and proton-antiproton interactions. (auth)

36259 A NEW PHENOMENOLOGICAL SUPERMULTIPLET STRUCTURE OF ELEMENTARY PARTICLES. P. Roman (Boston Univ.). Nucl. Phys., 57: 55-64(Aug. 1964).

Grouping together the known strongly interacting particles and resonances according to their spin value J and disregarding isospin, a simple two-parameter linear mass formula is found. One parameter characterizes each entire supermultiplet, the other varies from subset to subset. This second quantum number, together with isospin T, defines the hypercharge U and a new quantum number V, such that when taking also parity into account no degeneracy is left in the scheme. The mass formula is refined to incorporate isospin. A possible group theoretical background is suggested, which is based on the group U_4. The symmetry breaking terms are discussed on general grounds. The possibility of incorporating electromagnetic and weak interactions is indicated. (auth)

36260 INVARIANT QUANTITIES IN SEMI-SIMPLE GROUPS. [PART] III. M. Umezawa (Institut de Recherches Nucléaires, Strasbourg). Nucl. Phys., 57: 65-88(Aug. 1964).

The investigation of the invariant operator of the unitary unimodular group is completed. We deal with non-symmetrical invariant operators as well as symmetrical invariant operators. It is found that any invariant operator can be expressed as a sum of a series in terms of fundamental invariant operators and their products. Therefore the eigenvalue of any invariant operator can also be expressed as a sum of a series of eigenvalues of fundamental invariants and their products. For the purpose of defining the irreducible representation by the eigenvalues of a set of invariants, a set of invariant operators of simple eigenvalues is investigated. (auth)

36261 REMARKS ON STRANGENESS NON-CONSERVING WEAK LEPTONIC INTERACTIONS. Sadao Oneda (Univ. of Maryland, College Park). Nucl. Phys., 57: 89-95(Aug. 1964).

The possibility that both the leptonic currents and the vector K-π resonance, M, couple with the same strangeness changing currents is discussed. The magnitude of renormalized coupling constant and the form factors of $K_{\mu 3}$-decay are discussed. A reasonable consistency with the present experimental situations with regard to the leptonic strangeness changing processes and to the K-π resonances is indicated. (auth)

36262 PRESENT STATUS OF THE CONSERVED VECTOR CURRENT THEORY. R. J. Blin-Stoyle (Univ. of Sussex, Brighton, Eng.). Nucl. Phys., 57: 232-44 (Aug. 1964).

A critical survey is given of the theoretical implications of the various experiments which are normally quoted as

favoring the conserved vector current theory. It is concluded that although experiments are in general consistent with the theory, it is not clear that they are inconsistent with a theory in which the polar vector current is not conserved. (auth)

36263 THRESHOLD EFFECTS AND UNSTABLE PARTICLES. Luciano Fonda and Gian Carlo Ghirardi (Università, Trieste, Italy and Istituto Nazionale di Fisica Nucleare, Trieste, Italy). Nucl. Phys., 58: 374-84(Sept. 1964).

The anomalous behavior of cross sections at the threshold for a reaction involving unstable particles is derived by making use of the unitarity of the S-matrix and of analyticity arguments. Both the case of metastable particle production and that of virtual particle (antibound) production are discussed. (auth)

36264 A MODEL OF NON-LOCAL PION NUCLEON INTERACTION. Guru Vachan Dass and Tulsi Dass (Univ. of Delhi). Nucl. Phys., 58: 432-8(Sept. 1964).

A separable potential for the $I = {}^3/_2$, $P_{\frac{3}{2}}$ state of the pion-nucleon system is constructed which approximately incorporates the Mandelstam singularities in the partial wave amplitude. The 3-3 phase shifts up to 220 Mev are correctly reproduced. As an application, the rescattering correction to the isovector nucleon form factors is evaluated within the framework of dispersion theory and the results are compared with those of Frazer and Fulco. The possibility of obtaining, in this model, the Y_1^* (1385 Mev) and the Ξ^* (1535 Mev) as global-symmetric analogues of the 3-3 resonance, is also investigated. (auth)

36265 THE DALITZ PAIR IN $\Sigma^0 \rightarrow \Lambda^0 + e^- + e^+$ AND THE Σ^0-Λ^0 RELATIVE PARITY. Houchang Rouhaninejad (Centres de Recherches Nucléaires, Strasbourg). Nucl. Phys., 58: 458-64(Sept. 1964). (In French)

In order to establish how the Σ^0-Λ^0 relative parity ϵ can be measured from the polarized Σ^0 by means of the process $\Sigma^0 \rightarrow \Lambda^0 + e^- + e^+$ followed by Λ^0 decay, a correlation function depending on ϵ and the energies and momenta of the different particles involved was constructed. This is done by using a phenomenological Σ^0-Λ^0-γ current. (auth)

36266 THE STUDY OF (Σ-π) RESONANCE AT 1405 Mev IN EMULSIONS. A. Z. M. Ismail, S. Lokanathan, and Y. Prakash (Oxford Univ.). Nuovo Cimento (10), 33: 25-39(July 1, 1964).

The resultant momenta of 154 (Σ-π) pairs produced by K^- captures in emulsion nuclei were studied. No evidence for the existence of a sharp (Σ-π) resonance was observed The results seem to be in general agreement with the calculations of Adair for the distribution of the resultant (Σ-π) momentum expected from nuclear effects without any resonant interaction. The distribution of the total visible energy of the outgoing particles ($T_\Sigma + T_\pi + T_{recoil}$) suggests that several states of the recoil are formed from K^- captures in light emulsion nuclei. (auth)

36267 ON THE ELECTRON ENERGY SPECTRA OF THE V–A INTERACTION. S. Sniegocki (Inst. of Physics, Warsaw). Nuovo Cimento (10), 33: 55-63(July 1, 1964).

A covariant formula for the electron energy spectrum of a fermion emitted in the 4-fermion decay is deduced from the standard V–A interaction. The masses of all these fermions are parametrized. The electron energy spectra of the muon, neutron, and hyperon decays are obtained in the standard calculus, but from one general formula and without any approximations with respect to the masses of decay products, as compared to the mass of a decaying particle. A part of Friedberg's results is rederived. It is pointed out why the electron energy spectrum of muon decay is described correctly by zero-order approximation with respect to $z = (m_{\nu_\mu}^2 + m_{\nu_\beta}^2)/m_\mu^2 + m_e^2 - 2m_\mu E)$. From an exact formula for the electron energy spectrum of the neutron β-decay (in the case of the standard V–A interaction) the phase space electron energy spectrum is found as a zero-order approximation with respect to the terms $\sim m_e/M$ (m_e, M = electron and nucleon masses). This approximation should be valid as long as the experimental accuracies will be $\Delta E/E \geq m_e/M$ and $\Delta(C_A/C_V) \leq m_e/M$ (C_A, C_V = axial-vector and vector coupling constants). Any deviations, of order of magnitude larger than m_e/M, of the electron energy spectrum of neutron decay from the phase-space form cannot be explained by the kinematical and radiative corrections only. These corrections are of almost the same order of magnitude as the corrections caused by weak Gell-Mann magnetism. The approximation for the electron energy spectra of hyperon decays is discussed in the order $[(A - B)/B]^4$ (A = decaying hyperon mass, B = heavy decay product mass). Some covariant integrals are generalized to the arbitrary masses of the corresponding four-momenta involved there. (auth)

36268 UNITARY SPIN SELECTION RULES FOR WEAK INTERACTIONS. D. Horn (Univ. of Tel-Aviv, Israel). Nuovo Cimento (10), 33: 64-9(July 1, 1964).

Several unitary spin selection rules for weak interactions are proposed. Their implications are derived and compared with the present experimental and theoretical situation. (auth)

36269 RESONANCES IN THE SCATTERING OF PSEUDOSCALAR MESONS. Hong-Mo Chan (CERN, Geneva), P. C. DeCelles, and J. E. Paton. Nuovo Cimento (10), 33: 70-93(July 1, 1964). (TID-20149)

The bootstrap mechanism of Zachariasen and Zemach is used to study the resonant scattering of pseudoscalar mesons under the assumption of mass degeneracy and the existence of the vector resonances. The general bootstrap conditions on the mass and the coupling constants are formulated, and Capps' result on SU_3 symmetry is rederived from more general equations. The question of the possible existence of further resonances is reduced to a simple eigenvalue problem. The forces due to the vector exchange are found to be repulsive in the 10, $\overline{10}$ and 27 SU_3 channels but attractive in the 1 and 8, and when calculated with the self-consistent parameters are strong enough to bind scalar resonances in the 1 and 8 channels. These resonances may contribute to the interaction forces. Taking into account the scalar octet exchange in addition to the vector exchange the two octets were bootstrapped together in a double self-consistency calculation. A self-consistent solution is obtained at $m_v \sim 1000$ Mev, $m_s \sim 500$ Mev, and a small value for the ratio of the scalar coupling strength to the vector coupling strength (5%). The singlet scalar meson was not bootstrapped for the sake of simplicity, but it is believed that its effect should be small. Assignments of the weakly coupled K′ (725) to the $I = {}^1/_2$ members of the scalar octet, the K_1K_1 threshold anomaly to the I = 0 member of the octet, and the ABC particle to the scalar unitary singlet are made. Spin 2^+ particles are also predicted using the self-consistent parameters in the 1 and 8 channels at higher energies, the singlet being tentatively identified as f_0 while the octet occurs at presumably too high energies to be seen. Because of the crudeness of the model, no quantitative significance of the results is claimed, but the model is expected to be qualitatively correct and to give the right orders of magnitude for the various parameters. (auth)

36270 π^0 PHOTOPRODUCTION ABOVE 800 Mev. D. S. Beder (California Inst. of Tech., Pasadena). Nuovo Cimento (10), 33: 94-109(July 1, 1964). (TID-20567)

Meson(π^0) photoproduction above 800 Mev laboratory photon energy is discussed in terms of a vector-meson exchange and isobar model. Experimental data are shown to determine the ratios of magnetic to electric transition amplitudes to the second and third π-N isobars, and a tentative fit to cross sections is exhibited. Vector-meson exchange is shown to be essential to the description of the recoil nucleon polarization and the higher energy cross sections. Two polarization experiments are suggested which may contribute information about the third π-N isobar parity and about the ω-exchange amplitude sign. (auth)

36271 FURTHER NOTE ON COMPOSITENESS CONDITIONS. J. S. Dowker (Manchester Univ., Eng.). Nuovo Cimento (10), 33: 110-14(July 1, 1964).

Ignoring divergence problems the conditions $Z_1 = Z_3 = 0$ are shown to be plausible on quite general grounds. (auth)

36272 HARD-PHOTON EMISSION IN AN EXPERIMENT WITH ELECTRON-POSITRON COLLIDING BEAMS. U. Mosco (Università, Florence and Università, Pisa, Italy). Nuovo Cimento (10), 33: 115-32(July 1, 1964).

The radiative corrections to lowest order for the reaction $e^- + e^+ \rightarrow \mu^- + \mu^+$ are calculated, taking into account the contribution from high-energy photons emitted by the electrons. The correction to the total α^2 cross section is found to be ~5%, for colliding particles of 250 Mev. (auth)

36273 MESON BOOTSTRAPS AND G_2. Y. Ne'eman (California Inst. of Tech., Pasadena). Nuovo Cimento (10), 33: 133-6(July 1, 1964).

The negative result of the Chan, De Celles, and Paton G_2 vector meson bootstrap, based on their generation in two pseudoscalar mesons scattering, and a similar result in two vector meson scattering, are shown to derive from the fact that this model cannot assign the existing mesons to its adjoint representation. (auth)

36274 Λ-N POTENTIALS FROM SINGLE-PARTICLE EXCHANGES. B. W. Downs (Oxford Univ. and Atomic Energy Research Establishment, Harwell, Berks, Eng.) and R. J. N. Phillips. Nuovo Cimento (10), 33: 137-43(July 1, 1964).

It is shown that the observed features of the Λ-N interaction can be approximately reproduced by a sum of potentials, corresponding to the exchange of single scalar and pseudoscalar particles. A spin-independent hard core is assumed. (auth)

36275 DEPOLARIZATION OF ELECTRONS IN MATTER. C. Bouchiat and J. M. Levy-Leblond (Laboratoire de Physique Theorique et Hautes Energies, Orsay, France). Nuovo Cimento (10), 33: 193-200(July 1, 1964).

The depolarization of electrons or positrons by multiple scattering in infinite media is discussed. A semi-classical transport equation is used for the polarization density matrix. This integro-differential equation was solved by a moment method. (C.E.S.)

36276 A NEW TEST FOR THE SPIN-PARITY DETERMINATION OF STRANGE BARYONIC RESONANCES. E. de Rafael (Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette, France). Nuovo Cimento (10), 33: 237-40(July 1, 1964).

A strange baryonic resonance R produced in the parity-conserving reaction $m + p \rightarrow R + m'$, where m and m' are spinless mesons (π) or (K) and p is an unpolarized proton, is considered. The state R decays strongly into a fermion B(Λ, Σ, or Ξ) and a π. Subsequently B decays weakly into a fermion (N or Λ) and a π. A test for determining the spin of the R state and the R-B relative parity is outlined. (C.E.S.)

36277 INFLUENCE OF THE POLARIZABILITY ON THE SLOPE OF THE NEUTRON ELECTRIC FORM FACTOR. H. J. Kaiser (Joint Inst. for Nuclear Research, Dubna, USSR). Nuovo Cimento (10), 33: 241-2(July 1, 1964).

The effect of the neutron polarizability is considered as a possible explanation of the discrepancy of the values for the slope of the neutron electric form factor as determined from neutron-electron and deuteron-electron interaction experiments. (C.E.S.)

36278 REMARKS ON SU_3 TRIPLETS. W. Krolikowski (Inst. for Nuclear Research, Polish Academy of Sciences, Warsaw and Univ. of Warsaw). Nuovo Cimento (10), 33: 243-5(July 1, 1964).

A new additive quantity called Z in the spinor representations of SU_3 is discussed. The possibility of an alternative interpretation of Z as an additive quantity ascribed to baryons and mesons in such a way that $Z = \pm 1$ corresponds to new baryon and meson triplets and $Z = 0$ to presently known baryon and meson integral multiplets is proposed. New $Z = \pm 1$ triplets would comprise particles of integral charges (1,0,0) and (−1,0,0) respectively and hypercharges $(\frac{1}{3},\frac{1}{3},-\frac{2}{3})$ and $(-\frac{1}{3},-\frac{1}{3},\frac{2}{3})$ respectively. Their baryon numbers can be assumed to be integral. Since Z must be conserved in strong and electromagnetic interactions, new baryons and mesons would be created in acts of associated production of a new kind. (C.E.S.)

36279 NUCLEON FORM FACTORS WITH A FUNDAMENTAL LENGTH. R. L. Ingraham and D. T. Bailey (New Mexico State Univ., University Park). Nuovo Cimento (10), 33: 246-9(July 1, 1964).

It is pointed out that the fundamental length λ (equivalently: high momentum cut-off $\Lambda \approx \lambda^{-1}$ in S-matrix elements) depresses the dynamical form factors for low $q^2 \ll \lambda^{-2}$, where q^2 is the four-momentum transfer squared, gives rise to structure, that is, a flattening off or bumps, for intermediate $q^2 \approx X_0\lambda^{-2}$, where $X_0 = 0(1)$, and cuts off the dynamical form factors rather sharply at $q^2 \approx X_0\lambda^{-2}$ so that $G_E \approx G_M \approx$ a common kinematical form factor for large $q^2 \gg \lambda^{-2}$. This kinematical form factor falls of like $1/q^2$ for large q^2. A consistent theory of fundamental length arising from treating the underlying space-time coordinates as random rather than dispersionless variables is used. The fundamental length enters via the dispersion proportional to λ^2 of the coordinate random variables. (C.E.S.)

36280 PRODUCTION OF BARYON RESONANCES IN THE UNITARY SYMMETRY MODEL. M. Konuma (Scuola Normale Superiore, Pisa, Italy) and Y. Tomozawa. Nuovo Cimento (10), 33: 250-5(July 1, 1964).

Relations between the production amplitudes of baryon resonances in the meson-proton and antiproton-proton collisions are presented for the purpose of making an experimental test of the unitary-symmetry model in which a symmetry-breaking interaction is taken into account. (C.E.S.)

36281 ON A SPIN-PARITY TEST OF RESONANCES. H. Sugawara (Tokyo Univ.). Nuovo Cimento (10), 33: 256-8(July 1, 1964).

A spin-parity test of resonances that is based on the angular distributions of the production process is outlined. Several examples are discussed. (C.E.S.)

36282 AN ANALYSIS OF THE HYPERTRITON. R. C. Herndon (Univ. of California, Livermore), Y. C. Tang, and E. W. Schmid. Nuovo Cimento (10), 33: 259-63(July 1, 1964).

The binding energy of the hypertriton is analyzed by means of a trial wave function that was previously shown to give very accurate results in nuclear few-body problems. (C.E.S.)

36283 SEQUENT CORRELATIONS IN EVOLUTIONARY STOCHASTIC POINT PROCESSES AND ITS APPLICATION TO CASCADE THEORIES. S. K. Srinivasan and K. S. S. Iyer (Indian Inst. of Tech., Madras). Nuovo Cimento (10), 33: 273-85(July 16, 1964).

Sequent correlations in multiplicative stochastic processes are defined with the aid of product densities associated with the process. It is found that such correlation functions are very useful in the description of electromagnetic and perhaps nucleon cascades. To demonstrate this possibility, correlation functions of the first few orders are evaluated for the simple case of electron-photon cascade. (auth)

36284 COVARIANT ELECTRODYNAMICS OF CHARGED MESONS OF SPIN ONE WITH ARBITRARY ANOMALOUS MAGNETIC MOMENT. K. H. Tzou (Laboratoire de Physique Théorique et Hautes Energies, Orsay, France). Nuovo Cimento (10), 33: 286-308(July 16, 1964).

For charged mesons of spin one with arbitrary anomalous magnetic moment interacting with the electromagnetic field, it is shown that, within the framework of the conventional canonical formalism, a completely covariant S-matrix theory is possible, provided an additional meson field self-interaction of the nonlinear moment-moment type is introduced in the interaction Lagrangian. Moreover, it turns out that not only all noncovariant divergences, but also the "extra-high-order" covariant divergences due to meson anomalous magnetic moment are cancelled by the corresponding divergences arising from the additional moment-moment term. Finally, in meson-photon processes, the order of the divergences due to the two terms of the interaction by meson anomalous magnetic moment is not higher than that of the divergences arising from the electric charge interaction. Just as the usual gauge-invariance replacement procedure guarantees the relativistic covariance of the S-matrix in the case of electric charge interaction of a particle having a well defined spin, it is a general rule that, for assuring the same covariance in the case of anomalous moment interaction, this interaction is to be deduced from the replacement $f_{\mu\nu} \rightarrow f_{\mu\nu} + nM_{\mu\nu}$ in the free electromagnetic field Lagrangian. (auth)

36285 ON THE CONNECTION BETWEEN PRODUCTION MECHANISM AND DECAY OF RESONANCES AT HIGH ENERGIES. K. Gottfried and J. D. Jackson (CERN, Geneva). Nuovo Cimento (10), 33: 309-30(July 16, 1964).

The production of unstable particles in peripheral collisions at high energies is considered, with emphasis on the connection between the production mechanism and the angular correlations in the decay of the unstable particles. By means of the crossing relations for helicity amplitudes a direct relation is established between the t-channel helicity amplitudes and the spin-space density matrix (relative to a suitable system of co-ordinate axes) of one of the reaction products. The extent to which the decay angular distributions determine the density matrix is fully discussed. As an example, various quasi-two-body channels of K-N collisions are considered, especially K-N → K*-N. It is shown that, while the decay correlations of K* at 3 Bev/c are consistent with dominantly vector-meson exchange, they are also consistent with the exchange of systems with any $J \geq 1$, provided the parity is $(-1)^J$. This observation is used to generalize the one-meson-exchange model by means of Regge-pole exchange in a way which gives a natural explanation of the very peripheral nature of the production process, while maintaining agreement with the decay data. (auth)

36286 GENERALIZATION OF THE PHASE METHOD TO THE SCATTERING ON NONLOCAL POTENTIALS. F. Calogero (Università, Rome and Istituto Nazionale di Fisica Nucleare, Rome). Nuovo Cimento (10), 33: 352-60 (July 16, 1964).

The phase approach to scattering theory is extended to the case of scattering on nonlocal potentials. (auth)

36287 GREEN'S FUNCTION FORMULATION OF THE FEYNMAN MODEL OF THE POLARON. L. P. Kadanoff and M. Revzen (Univ. of Illinois, Urbana). Nuovo Cimento (10), 33: 397-412(July 16, 1964).

A relation between the true electronic Green's functions and the model Green's functions is developed which permits a calculation of all the properties of the real polaron in terms of the model Green's functions. This result is essentially similar to the earlier work of Schultz, except for a small but significant difference in the handling of the fictitious field of the model. The Green's function theory is used to calculate a transport equation for the polaron. The lowest-order transport equation is identical to that published earlier by Kadanoff at low temperatures. The derivation indicates, however, that Kadanoff's equation is wrong at high temperatures. (auth)

36288 DETERMINATION OF THE S-MATRIX FOR A SUPERPOSITION OF EXPONENTIAL POTENTIALS SINGULAR LIKE r^{-2} AT THE ORIGIN. H. Cornille (CERN, Geneva). Nuovo Cimento (10), 33: 434-54(July 16, 1964).

The Jost function and s-matrix are determined for the case of Yukawa generalized potentials with behavior near the origin as $-G/r^2$, $[G < (l + \frac{1}{2})^2]$. (D.C.W.)

36289 S-WAVE MESON-NUCLEON INTERACTIONS AND UNITARY SYMMETRY. S. Iwao (Universität, Bern). Nuovo Cimento (10), 33: 455-61(July 16, 1964).

Low-energy, s-wave meson-nucleon scattering is studied using unitary symmetry. The parameters characterizing the reactions are explained in terms of the vector-meson exchange mechanism. The validity of the model is investigated by the s-wave, partial-wave dispersion relation. (auth)

36290 LOW-ENERGY π-Λ SCATTERING IN THE STATE $P_{1/2}$, $T = 3/2$. P. Narayanaswamy and Lalit Kumar Pande (Delhi Univ.). Nuovo Cimento (10), 33: 468-72 (July 16, 1964).

An N/D calculation is performed for the $P_{1/2}$, $T = 3/2$ low-energy π-Λ scattering amplitude, using the method of Balázs. The method is, as such, less successful in yielding quantitative agreement with the experimental data, than it is in the case of Λ^* and the s-wave scattering length for $T = 3/2$. Some modifications that may improve the present result are discussed. (auth)

36291 πp PHENOMENOLOGY, (300 TO 1300) MEV. P. Auvil and C. Lovelace (Imperial Coll. of Science and Tech., London). Nuovo Cimento (10), 33: 473-519(July 16, 1964).

Elastic scattering experiments from 300 to 1300 Mev are analyzed by various techniques. The usual D_{13} and F_{15} assignments for the second and third resonances are sup-

ported. The fourth resonance is found to be F_{37}, and the 800-Mev π^+-p shoulder to be D_{35} inelastic. There are also indications of four more inelastic shoulders: in P_{11}(~400 Mev), S_{11}(~600 Mev), D_{15}(~700 Mev), and G_{17}(~1200 Mev). Both S waves increase steadily with energy, indicating a strong repulsive core. The background at the fourth resonance is strongly spin-dependent, in contradiction to the usual diffraction model. The imaginary parts of the partial amplitudes are obtained quantitatively over much of this region. The most powerful new condition is the requirement that the elasticities of the resonances, as determined from total cross-sections and forward dispersion relations, be compatible with the differential cross-sections there. (auth)

36292 THE $\gamma + \gamma \rightarrow \nu + \bar{\nu}$ PROCESS AND ITS IMPLICATION IN COSMOLOGY. D. Boccaletti, V. de Sabbata, and C. Gualdi (Instituto Nazionale di Fisica Nucleare, Bologna). Nuovo Cimento (10), 33: 520-6(July 16, 1964).

The cross section for the $\gamma + \gamma \rightarrow \nu + \bar{\nu}$ process is estimated, and photon destruction and neutrino pair production in the universe are briefly considered. (D.C.W.)

36293 REGGE POLES IN WEAK INTERACTIONS. [PART] I. K. Raman (Inst. of Mathematical Sciences, Madras). Nuovo Cimento (10), 33: 545-65(July 16, 1964).

An analysis is made of Regge poles in weak reactions involving two spin-half fermions and two spin-zero bosons, with particular reference to neutrino reactions on spinless targets and meson production in neutrino-electron collisions. The Regge-Khuri representation is used for obtaining the equations for the latter process; a method of solving for the amplitude is outlined. Numerical results are obtained in an effective-range approximation. The form factors governing the high-energy behavior of peripheral neutrino reactions are evaluated. Some of the difficulties that arise in an S-matrix approach to weak interactions are discussed. (auth)

36294 ON THE NUCLEON-ANTINUCLEON INTERACTION AT LOW ENERGIES. M. Ceschia (Università, Trieste, Italy and Istituto Nazionale di Fisica Nucleare, Trieste, Italy) and A. Perlmutter. Nuovo Cimento (10), 33: 578-93(July 16, 1964).

The Ball and Chew model for nonrelativistic N-$\bar{N}$ interactions was reexamined. The total and differential elastic cross sections and the polarization were calculated more precisely, with and without Coulomb scattering, for energies of 30 to 280 Mev, by using recently derived potentials for the outer region of the N-$\bar{N}$ interaction. (auth)

36295 A COVARIANT THEORY OF THE PHOTODISINTEGRATION OF THE DEUTERON. [PART] I. M. Le Bellac, F. M. Renard, and J. Tran Thanh Van (Laboratoire de Physique Théorique et Hautes Energies, Orsay, France). Nuovo Cimento (10), 33: 594-627 (July 16, 1964).

The interaction $\gamma + d \rightarrow n + p$ is calculated in the framework of a covariant theory. The twelve invariant amplitudes are related to helicity amplitudes and then to multipole amplitudes. A general formula is written explicitly for the calculation of any multipole amplitude from the twelve invariant amplitudes. The Born terms are derived and are then modified to take account of deuteron structure by using n-p-d vertex functions depending on the transfer. The corresponding cross section as well as the 10 dipole and 12 quadrupole amplitudes are calculated. It is shown that the octupole terms are not completely negligible for incident photon energies of about 100 Mev. The theory is equivalent in the low-energy limit to the usual nonrelativistic theory based upon Siegert's theorem and excluding final-state interactions, but some of the multipole amplitudes seem to be affected by relativistic corrections for energies of order 100 Mev. Comparison with experiment shows very good agreement in view of the approximations made. (auth)

36296 BARYON-PS-MESON COUPLINGS AND UNITARY SYMMETRY. E. Eberle (Università, Genoa and Istituto Nazionale di Fisica Nucleare, Genoa). Nuovo Cimento (10), 33: 628-32(July 16, 1964).

The baryon-ps-meson coupling constants are evaluated in a broken SU3-symmetry model based on the $\varphi^{(0)}$-$\omega^{(0)}$ mixing. Since only one parameter is introduced by the model, a meaningful numerical comparison is possible with the existing data about those coupling constants. The agreement is satisfactory. (auth)

36297 RADIATIVE DECAY OF THE MUON VIA W-BOSON. D. Bailin (Princeton Univ., N. J.). Nuovo Cimento (10), 33: 633-42(July 16, 1964).

The electron energy spectrum at a fixed angle with the photon in radiative muon decay was calculated. In addition, the photon energy spectrum and the transition probability of the photon having an energy greater than some fixed value were derived. (auth)

36298 PROTON-PROTON ELASTIC SCATTERING AT HIGH-ENERGIES. G. Cocconi (CERN, Geneva). Nuovo Cimento (10), 33: 643-53(July 16, 1964).

The behavior of the high-energy cross-section for proton-proton elastic scattering as a function of proton energy and angle of emission is discussed. While small angle scattering is due to diffraction, large angle scattering seems to result from a statistical process. Several theoretical and experimental questions raised by these results are discussed. (auth)

36299 MASS RELATIONS CONNECTING VECTOR AND PSEUDOSCALAR MESONS IN UNITARY SYMMETRY. P. Babu (Tata Inst. of Fundamental Research, Bombay). Nuovo Cimento (10), 33: 654-6(July 16, 1964).

Mass formulas are derived using a model in which the vector and pseudoscalar octets and the vector singlet are considered as bound states of the same fundamental triplets. (D.C.W.)

36300 PARTICLE NUMBER AND ENERGY FLUCTUATIONS. J. Hoegaasen (Norges Tekniske Hogskole, Trondheim, Norway). Nuovo Cimento (10), 33: 665-7(July 16, 1964).

An upper limit on particle number fluctuations and a lower limit on energy fluctuations in the quasi-particle approximation are given. (D.C.W.)

36301 OSCILLATOR MODEL FOR PARTICLES UNDERLYING UNITARY SYMMETRY. T. Takabayasi (Nagoya Univ., Japan). Nuovo Cimento (10), 33: 668-72(July 16, 1964).

A unified model for baryons and their excitations is presented, assuming the existence of three internal co-ordinate vectors $x_\mu^{(r)}$ (r = 1,2,3) instead of the single x_μ of Yukawa. (D.C.W.)

36302 EXPERIMENTAL STUDY OF THE $\pi^+ + d \rightarrow p + p$ REACTION BETWEEN 0.65 AND 1.95 Gev/c. D. Dekkers, (CERN, Geneva), B. Jordan, R. Mermod, C. C. Ting, G. Weber, T. R. Willitts, K. Winter, X. De Bouard, and M. Vivargent. Phys. Letters, 11: 161-4(July 15, 1964).

The differential and total cross sections of the $\pi^+ + d \rightarrow p + p$ reaction were investigated for energies between 0.65 and 1.95 Bev/c. (C.E.S.)

36303 POSSIBLE EXISTENCE OF A B = 2, S = −1 RESONANCE. P. A. Piroue (Princeton Univ., N. J.). Phys. Letters, 11: 164-7(July 15, 1964).

A mass analysis was made of particles emitted from a Be target when struck by 2.95-Bev protons. At 30° relative to the direction of the proton beam it was found that the K^+ momentum spectrum exhibited a rather large deviation from the expected phase space. One possible explanation for this deviation is the existence of a B = 2, S = −1 resonance at 2.36 Bev (e.g., a Ap resonance). (C.E.S.)

36304 EVIDENCE FOR AN ISOSCALAR $\rho\pi$ RESONANCE AT 975 Mev. J. Bartsch (Technische Hochschule, Aachen), L. Bondar, W. Brauneck, et al. Phys. Letters, 11: 167-70(July 15, 1964).

Evidence for the production of an isoscalar $\rho\pi$ resonance at 975 Mev in π^+-p interactions at 4.0 Bev/c is presented. (C.E.S.)

36305 NEUTRAL PION PRODUCTION BY 9 Gev/c NEGATIVE PIONS IN XENON. Z. S. Strugalski and T. Siemiarczuk (Inst. of Nuclear Research, Warsaw). Phys. Letters, 11: 170-2(July 15, 1964).

Properties of meson (π^0) production in meson (π^-) reactions with Xe nuclei at 9 Bev/c were investigated. The meson (π^0) multiplicity distributions for interactions in different intervals of prong multiplicities were constructed. The dependence of the average number of mesons (π^0) per interaction on the observed prong multiplicity is shown. (C.E.S.)

36306 ON THE REACTION $\bar{p} + p \rightarrow K_1^0 + K_2^0$ IN SCHWINGER'S $U_3 \otimes U_3$ SYMMETRY. W. Alles (CERN, Geneva). Phys. Letters, 11: 176(July 15, 1964).

It is shown that the $\bar{p} + p \rightarrow K_1^0 + K_2^0$ interaction is forbidden in Schwinger's $U_3 \otimes U_3$ symmetry. The production of $^3/_2{}^+$ baryons in meson-nucleon interactions is also discussed. (C.E.S.)

36307 ELASTIC CHARGE EXCHANGE AND η PRODUCTION BY NEGATIVE PIONS OF 4 Gev/c. H. Faissner, F. Ferrero, H. J. Gerber, M. Reinharz, and J. Stein (CERN, Geneva). Phys. Letters, 11: 178-81(July 15, 1964).

The behavior of mesons (π^0) produced by elastic charge exchange was investigated at 4 Bev/c. A total cross section for elastic charge exchange is presented. An angular distribution which is peaked in the forward direction was obtained. A kinematical analysis of the events revealed a number of mesons (η) produced with the full incident energy and decaying into two gammas. (C.E.S.)

36308 NOTE ON POSSIBLE EXISTENCE OF SCALAR AND AXIAL VECTOR OCTETS. Riazuddin and R. E. Marshak (Univ. of Rochester, N. Y.). Phys. Letters, 11: 182-4(July 15, 1964).

Evidence is presented for the existence of a scalar octet having CP = −1. It is shown that the scalar octet of particles would be coupled to pairs of baryons or pseudoscalar mesons only to the extent that electromagnetic and medium strong mass differences are not neglected. The masses of the members of this octet are discussed. The axial vector octet is also considered. The masses of the axial vector octet and their couplings with other particles are also discussed. (C.E.S.)

36309 ASYMMETRY OF THE $\pi^+ \rightarrow \mu^+ \rightarrow e^+$ DECAY-ELECTRON ANGULAR DISTRIBUTION IN A LONGITUDINAL MAGNETIC FIELD OF 140,000 GAUSS. I. I. Gurevich (Kurchatov Atomic Energy Inst., Moscow), L. A. Makariyna, B. A. Nikol'skii, B. V. Sokolov, L. V. Surkova, S. Kh. Khakimov, V. D. Shestakov, Yu. P. Dobretsov, and V. V. Akhmanov. Phys. Letters, 11: 185-8(July 15, 1964).

The angular distribution of $\pi^+ \rightarrow \mu^+ \rightarrow e^+$ decay positrons was studied with a longitudinal magnetic field of 140,000 gauss. An emulsion stack inside a magnetic coil was exposed to a meson (π^+) beam. Asymmetry coefficients were determined. (C.E.S.)

36310 S-WAVE TWO-BARYON INTERACTIONS AND UNITARY SYMMETRY. S. Iwao (Universität, Bern). Phys. Letters, 11: 188-9(July 15, 1964).

An account of the S-wave two-baryon interaction in terms of the octet version of the unitary symmetry model of Gell-Mann and Ne'eman is presented. A non-bound state of the Σ^- system and a bound state of Ξ^-n in the $^1S_0$ are predicted. It is also predicted that $\Xi^-n \rightarrow \Sigma^-\Sigma^0$ production occurs only through the even spin-space state if the charge independence holds. Several cross sections are also predicted by making use of NN, AN, and ΛΛ interaction parameters in the S-state. (C.E.S.)

36311 SU_4 AND STRONG INTERACTIONS. D. Amati, H. Bacry, J. Nuyts, and J. Prentki (CERN, Geneva). Phys. Letters, 11: 190-2(July 15, 1964).

Models based on the SU_4 group and further predictions concerning mass formulas are investigated. (C.E.S.)

36312 PROTON-PROTON SCATTERING NEAR THE INTERFERENCE MINIMUM AND THE SHAPE PARAMETER. J. E. Brolley, Jr., J. D. Seagrave, and J. G. Beery (Los Alamos Scientific Lab., N. Mex.). Phys. Rev., 135: B1119-27(Sept. 7, 1964). (LADC-6010)

At a laboratory proton energy of 382.43 kev, p-p scattering exhibits nearly complete destructive interference, and the s-wave phase shift may be determined from the location, E_{min}, of the minimum in the cross section for 90°c.m. scattering, with comparable precision. A determination of the phase shift at E_{min} to one part in 10^3 may be continued with recent results between 1.4 and 3 Mev to give information about the shape-dependent term in the effective-range expansion. Measurements were made of the relative cross section at six energies near that of the minimum, using a scattering chamber with annular slits of 90° vertex angle and a group of coincident pairs of silicon particle detectors. The energies of the data points were established by a radio-frequency, time-of-flight absolute velocity gage, with an uncertainty of less than 50 ev. The scattering chamber was differentially pumped upstream and downstream. The operating pressure was 0.3 torr, and the upstream energy loss of about 150 ev was measured directly by noting the offset of the $^{19}F(p,\alpha\gamma)^{16}O$ resonance when hydrogen was present in the chamber between the velocity gage and a differentially pumped CF_4 gas target. The minimum was relocated at E_{min} = 382.43 ± 0.20 kev, and the corresponding s-wave phase shift with respect to the electric wave functions including vacuum polarization is found to be δ_0^E = 0.25501 ± 0.00020 rad. The shape-dependent parameter inferred from these results is significantly positive, P = +0.028 ± 0.014. This may be considered strong evidence in favor of one-pion-exchange effects in the s-wave interaction. (auth)

36313 SU_3 INVARIANCE IN NUCLEON-ANTINUCLEON ANNIHILATION. K. Tanaka (Argonne National Lab., Ill.). Phys. Rev., 135: B1186-90(Sept. 7, 1964).

The relations among the amplitudes for nucleon-antinucleon annihilation into two mesons, and also those for annihilation into a baryon-antibaryon pair and a decuplet-antidecuplet pair, are obtained on the basis of SU_3 invariance. The dynamical assumptions made are that for the

two-meson case the 8 representations dominate the direct channel and that for the baryon-antibaryon pair case, the 8a and 27 representations dominate the crossed channel. The relations are compared with experiments, and some resulting tee's of SU_3 invariance are suggested. (auth)

36314 S-MATRIX METHOD FOR CALCULATION OF ELECTROMAGNETIC CORRECTIONS TO STRONG INTERACTIONS. Roger F. Dashen and Steven C. Frautschi (California Inst. of Tech., Pasadena). Phys. Rev., 135: B1190-5(Sept. 7, 1964).

An S-matrix method is developed for calculating the effect of small perturbations on a partial-wave amplitude, and in particular, on the positions and residues of bound states. The method is applicable to both non-relativistic and relativistic problems. It has, as a particular virtue, rapid convergence of the dispersion integrals. Electromagnetic corrections to strong interactions are the main application, and modifications useful for handling the infrared divergence that occurs in this case are described in detail. (auth)

36315 CALCULATION OF THE PROTON-NEUTRON MASS DIFFERENCE BY S-MATRIX METHODS. Roger F. Dashen (California Inst. of Tech., Pasadena). Phys. Rev., 135: B1196-1202(Sept. 7, 1964).

The proton-neutron mass difference is calculated using S-matrix methods developed previously. Neutrons and protons are treated as bound-state poles in the π-N scattering amplitude, and the mass difference is obtained by finding the electromagnetic corrections to their binding energies. The results are in good agreement with experiment. No cutoffs or other purely theoretical parameters are involved. All the long-range electromagnetic corrections to the π-N interaction are investigated. Photon exchange turns out to be the most important. Form factors appear as short-range modifications of the photon exchange force. The results of the calculation are not sensitive to the detailed behavior of the form factors at large momentum transfer. (auth)

36316 CALCULATION OF THE RATE OF $\Omega^- \to \Xi^0 + e^- + \bar{\nu}$. Joel Yellin (Univ. of Chicago). Phys. Rev., 135: B1203-4(Sept. 7, 1964). (EFINS-64-19)

The rate of electronic decay of the Ω^- hyperon is calculated, making the assumptions of Cabibbo and using a Goldberger-Treiman relation for the axial vector part. The final result contains one free parameter. (auth)

36317 ESTIMATIONS OF HIGH-ENERGY PHOTOPION PRODUCTION AT 0^0. Uri Maor (Stanford Univ., Calif.). Phys. Rev., 135: B1205-11(Sept. 7, 1964).

Experimental measurements indicate a much higher cross section than one-pion-exchange predictions for high-energy charged-pion photoproduction at very small angles. Some possible mechanisms for 0^0 high-energy pion photoproduction are examined. It is shown that double pion photoproduction via a Reggeized ρ-exchange process may yield a considerable cross section at $\theta_\pi = 0^0$. The parameters of the ρ trajectory are determined and compared with other calculations. Since the residue of the ρ trajectory is unknown, an experiment in a deuterium bubble chamber is suggested. The results are applied also to higher photon energies. (auth)

36318 K-3π DECAY AND $K_2^0 - K_1^0$ MASS DIFFERENCE ON CURRENT-CURRENT PICTURE. Riazuddin and A. H. Zimerman (Univ. of Rochester, N. Y.). Phys. Rev., 135: B1211-14(Sept. 7, 1964). (UR-875-29)

Some consequences of the current-current picture are considered in connection with K-3π decay and the $K_2^0 - K_1^0$ mass difference. It is shown that this picture in boson pole approximation can explain both the decay rates and spectra for the 3π decay modes of K. The $K_2^0 - K_1^0$ mass difference is considered in terms of a boson pole approximation and a two-pion intermediate state. The relevant weak-coupling constants are estimated on the current-current picture. It is shown that the sign of the mass difference ($\delta m = \delta m_{K_2^0} - \delta m_{K_1^0}$) is positive, which is in agreement with recent experimental indications. The magnitude is somewhat small but it is not excluded by the experimental situation. (auth)

36319 INNER BREMSSTRAHLUNG IN MUON DECAY. Charles A. Rey (Univ. of Chicago). Phys. Rev., 135: B1215-24(Sept. 7, 1964).

A measurement of inner bremsstrahlung in muon decay was made using spark chambers, scintillators, and fast oscilloscopes. The electron range distribution in graphite and the absolute rates were determined for electron–gamma-ray angles between 130 and 180 deg. For the electron and gamma-ray energies studied, the branching ratio of $\mu \to e + \gamma + \nu + \bar{\nu}$ to $\mu \to e + \nu + \bar{\nu}$ is predicted to be about 10^{-4} over this angular range. The total number of inner bremsstrahlung events observed was 1805 ± 43, which is in agreement with an expected number of 1889 ± 283. The data were found to be in accord with the predictions given by electromagnetic corrections applied to the weak interaction. (auth)

36320 PRACTICAL THEORY OF THREE-PARTICLE STATES. I. NONRELATIVISTIC. C. Lovelace (Imperial Coll. of Science and Tech., London). Phys. Rev., 135: B1225-49(Sept. 7, 1964).

Faddeev's mathematical work on nonrelativistic three-particle systems is used to obtain a practical theory of three-particle states. Each of the two-particle subsystems is assumed to be dominated by a finite number of bound states and resonances. Two sets of equations are obtained. One expresses processes with three final particles in terms of unstable-particle scattering. It generalizes and justifies the isobar model. The other is a set of coupled Lippmann-Schwinger equations for the scattering of bound states and unstable particles. The potentials in these scattering equations for composite particles are nonlocal and energy-dependent, and become complex above the three-particle threshold. They are expressed in terms of the wave functions of the two-particle bound states and resonances—there are no new arbitrary constants. The solution satisfies three-particle unitarity. Unstable particles are not approximated by stable ones. The theory applies especially to overlapping final-state interactions. The equations are given in detail for the 3N and N$\pi\pi$ systems in the static limit. In the latter case, the nucleon is treated as an Nπ bound state. The N$\pi\pi$ equations are solved approximately in closed form, giving analogs of the Chew-Low effective-range formula, for the coupled Nπ and N*π systems. This predicts large inelasticity in the P_{11} state, in agreement with experiment. If all elementary particles are treated as bound states of themselves, the approach gives the basis of a complete dynamical theory of strong interactions. (auth)

36321 UNIFICATION OF PHOTOPRODUCTION AND ELECTROPRODUCTION. S. M. Berman (Stanford Univ., Calif.). Phys. Rev., 135: B1249-54(Sept. 7, 1964). (SLAC-Pub-27)

Gauge invariance and the vector nature of the photon are exploited in order to factor expressions for cross sections of photon-induced reactions into a purely kinematical part and a purely dynamical part. Detailed studies of two- and three-body final states are considered, and it is shown how this separation into kinematical and dynamical aspects

provides a useful and general procedure by which to compare experiment and theory. (auth)

36322 TIME AND THE S MATRIX. David Branson (Cambridge Univ., Eng.). Phys. Rev., 135: B1255-62 (Sept. 7, 1964).

A method is introduced for defining the time duration of a scattering process. Using this definition, the connection between causality and analyticity is discussed. An application to three-particle scattering leads to a discussion of the necessity for the existence of stable and unstable particle poles, and an analysis is given of rescattering processes and the generation of two-particle normal thresholds, with a view to obtaining Feynman's $i\epsilon$ prescription for deciding which is the physical boundary value. (auth)

36323 PHENOMENOLOGICAL APPROACH TO EXPLAIN THE BEHAVIOR OF THE DIFFRACTION PEAK IN HIGH-ENERGY SCATTERING. Shigeo Minami (Louisiana State Univ., Baton Rouge). Phys. Rev., 135: B1263-9 (Sept. 7, 1964).

It is pointed out that the observed shrinkage of the diffraction peaks in both p-p and K^+-p scattering does not necessarily correspond to the shrinkage predicted by Regge-pole theory, an upper limit to the width of the diffraction peak can be predicted from a theoretical point of view, and the observed widths of the diffraction peaks can be explained in terms of total cross sections and a parameter having the same value for various kinds of meson-nucleon scattering (similarly for nucleon-nucleon and nucleon-antinucleon scattering). (auth)

36324 SOLUTIONS IN PION-PION SCATTERING FOR TWO ρ MESONS. I. R. Gatland and J. W. Moffat (Research Inst. for Advanced Studies, Baltimore). Phys. Rev., 135: B1272-73(Sept. 7, 1964).

The theory of pion-pion scattering with inelastic effects is applied to the experimental evidence for the B particle which in interpreted as a second resonance in the $J = 1^-$ pion-pion scattering amplitude. The full width of the B particle is predicted and the positions of the ρ and B particles are found to be consistent with the assumption that the $\pi-\omega$ channel dominates the inelastic intermediate state. (auth)

36325 EXPECTATION VALUES OF VARIOUS OPERATORS IN THE TRITON. L. M. Delves (Univ. of New South Wales, Kensington, Australia and New York Univ., New York). Phys. Rev., 135: B1316-19(Sept. 21, 1964).

The trial functions used in a calculation of the triton binding energy with realistic forces were used to derive the expectation values of a number of operators. These include the Coulomb energy for point and for finite protons; various products of powers of the interparticle distances; and the charge and magnetic moment form factors as given by Schiff. (auth)

36326 LARGE SYMMETRY BREAKING AND MASS RELATIONS. Ching-Hung Woo (Inst. for Advanced Study, Princeton, N. J.). Phys. Rev., 135: B1352-5(Sept. 21,1964).

The effects of symmetry breaking on the multiplet structure of composite particles are studied. The Sakata triplet is used for illustrations, and simple special models are studied where some mass regularities remain even in the presence of a fairly large symmetry breaking. (auth)

36327 CONNECTION BETWEEN THE RELATIVISTIC AND NONRELATIVISTIC FORM OF THE NUCLEON-NUCLEON AMPLITUDE. A. O. Barut and M. Samiullah (Univ. of Colorado, Boulder). Phys. Rev., 135: B1356-8 (Sept. 21, 1964).

The connection between the nonrelativistic (Wolfenstein-Ashkin) and the relativistic (Goldberger-Grisaru-McDonald-Wong) amplitudes of the nucleon-nucleon scattering is obtained using a two-component form of the latter. This connection involves simple functions of E and cos θ. It is then possible to translate the analysis of scattering and polarization experiments in terms of one set of amplitudes into the other. (auth)

36328 BREAKING OF SU(3) SYMMETRY IN THE $^3/_2^+$ MESON-BARYON DECUPLET. K. C. Wali (Argonne National Lab., Ill.) and Robert L. Warnock. Phys. Rev., 135: B1358-68(Sept. 21, 1964).

Breaking of SU(3) invariance is studied in the case of the meson-baryon decuplet with $J^P = {}^3/_2{}^+$. In a simple theory based on single-baryon exchange, the evolution of the broken decuplet from a degenerate origin is traced in detail. Symmetry breaking is introduced by allowing initially degenerate meson and baryon masses to approach continuously their physical values, while obeying at every stage the Gell-Mann-Okubo sum rules. The following conclusions are reached: The Okubo equal spacing rule for the decuplet levels follows from the validity of the Gell-Mann-Okubo rules for the meson and baryon octuplets. The main effect of the symmetry breaking may be characterized as a mixing of the 10- and 27-dimensional representations. The mixing is small enough so that the resonances can be unambiguously associated with the 10 representation, but at the same time large enough to imply coupling-constant ratios differing appreciably from the values for pure symmetry. In the approach to pure symmetry through reduction of mass differences, there are no difficulties of the type pointed out by Oakes and Yang. Resonances cross thresholds smoothly, and a degenerate decuplet of bound states is obtained in the limit. (auth)

36329 DEPOLARIZATION OF SPIN-$^1/_2$ PARTICLES BY ELECTROMAGNETIC SCATTERINGS. C. K. Iddings, G. L. Shaw, and Y. S. Tsai (Stanford Univ., Calif.). Phys. Rev., 135: B1388-97(Sept. 21, 1964).

A study is made of the depolarization of polarized, relativistic fermions (spin $^1/_2$) passing through matter. The final polarization of the projectile shows two features, (i) a rotation of the polarization vector so that it does not have the same direction as the initial polarization with respect to the initial or final momenta: rotation; (ii) an unpolarized component so that the magnitude of the polarization has diminished: shrinkage. The scattering of the incident polarized fermion off unpolarized target electrons and nuclei to lowest order in α is considered. Whereas to this order no polarization can be produced, i.e., the magnitude of the polarization vector cannot increase, the magnitude of the spin vector can decrease if the target has spin. General formulas are presented for the spin-$^1/_2$ particles scattered electromagnetically from an unpolarized target with arbitrary spin in terms of form factors. Numerical results are presented for processes (i) and (ii) in the cases of positrons and muons scattered by unpolarized electrons. Process (ii) is proportional to t^2 (for small momentum transfer t). If one expands the expressions for the polarization phenomena keeping only the linear term in t, then the shrinkage (ii) vanishes and the rotation effects (i) all reduce to those for the pure Coulomb scattering case. (As is well-known the depolarization due to Coulomb scattering is negligible for small-angle scattering.) However, if one is concerned with particles scattered into a sizeable solid angle, then the rotation effects in, e.g., positron-electron scattering become enormously larger than that given by Coulomb scattering; they become strongly dependent on the

relative orientation of the incident polarization vector: much larger rotations occur for transversely polarized beams; one cannot omit the contribution from the annihilation diagram compared to that from the direct one-photon exchange; and most important the depolarization due to shrinkage is comparable to the rotational effects. In multiple scattering, the shrinkage is a cumulative effect whereas the rotational contribution to depolarization is a random walk process. (auth)

36330 RENORMALIZABLE ELECTRODYNAMICS OF SCALAR AND VECTOR MESONS. [PART] II. Abdus Salam (Imperial Coll. of Science and Tech., London) and Robert Delbourgo. Phys. Rev., 135: B1398-1427(Sept. 21, 1964). (TID-20566)

The gauge technique for solving field theories introduced earlier is applied to scalar and vector electrodynamics. It is shown that for scalar electrodynamics there is no $\lambda\varphi^{*2}\varphi^2$ infinity in the theory, while with conventional subtractions vector electrodynamics is completely finite. The essential ideas of the gauge technique are explained, and a preliminary set of rules for finite computation in vector electrodynamics is outlined. (auth)

36331 ASYMPTOTIC BEHAVIOR OF THE SCATTERING AMPLITUDE AND NORMAL AND ABNORMAL SOLUTIONS OF THE BETHE-SALPETER EQUATION. Noboru Nakanishi (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 135: B1430-6(Sept. 21, 1964). (BNL-8025)

An integral equation for a scattering amplitude is considered in the ladder approximation. It is assumed that two scalar particles having mass m exchange scalar photons except for the first step, in which a scalar meson having mass 2m is exchanged. The exact solution to this equation is found in a compact form in the case of zero energy. Asymptotic behavior of the solution is investigated in the crossed channel. It is shown that the leading term and the second leading term in the asymptotic expansion in t exactly correspond to the normal solutions of the Bethe-Salpeter equation with n = l + 1 and those with n = l + 2, respectively, where n is the principal quantum number. (auth)

36332 UNITARY SYMMETRY AND HYPERON LEPTONIC DECAYS. L. Wolfenstein (Carnegie Inst. of Tech., Pittsburgh). Phys. Rev., 135: B1436-41(Sept. 21, 1964).

The consequences (beyond the $\Delta I = \frac{1}{2}$ and $\Delta I = 1$ rules) of the most general form of the hypothesis that the weak-interaction currents transform like components of SU_3 octets are discussed. These are presented as relations between the $\Delta S = 1$ leptonic decays of Ξ^- and Ξ^0 and those of Σ and Λ. The only prediction for the branching ratios B of Ξ decays which can be compared to present experiments is $B(\Xi^- \to \Lambda + e^- + \nu) + B(\Xi^- \to \Sigma^0 + e^- + \nu) \leq (1.05 \pm 0.2) \times 10^{-3}$. As yet the comparison is inconclusive. One additional relation among the leptonic decays of hyperons is found if the particular model of Cabibbo is assumed. Applications of these considerations to the determination of induced couplings are made. (auth)

36333 SUM RULES FOR THE DECAY OF THE BARYON DECUPLET INTO THE BARYON AND MESON OCTETS IN BROKEN SU(3) SYMMETRY. Virendra Gupta and Virendra Singh (Inst. for Advanced Study, Princeton, N. J.). Phys. Rev., 135: B1442-4(Sept. 21, 1964).

The sum rules for the decuplet → octet + octet coupling constants were investigated, taking into account the SU(3)-symmetry-breaking interactions to first order. There are seven sum rules for the possible twelve coupling constants. One of these sum rules involves only the coupling constants for the decays $N^* \to N\pi$, $Y_1^* \to \Lambda\pi$, $Y_1^* \to \Sigma\pi$, and $\Xi^* \to \Xi\pi$, all of which are experimentally known. The corresponding sum rules for $10^* \to 8 + 8$ decay are given. (auth)

36334 COUPLING OF INTERNAL AND SPACE-TIME SYMMETRIES. O. W. Greenberg (Univ. of Maryland, College Park). Phys. Rev., 135: B1447-50(Sept. 21, 1964).

When Lorentz invariance is ignored, internal symmetries which are violated in a given way, and which are independent of the space-time symmetries, can be rewritten in terms of a larger group which contains the internal group and the time-translation group in a coupled (noncommuting) way. This rewriting can be chosen so that the noncommutativity of the time-translation and internal groups splits the mass degeneracy of internal multiplets, i.e., accounts for what was previously called violation of the internal group. This procedure is illustrated explicitly for the SU(3) baryon octet with octet symmetry violation. When Lorentz invariance is required, the coupling of internal and space-time symmetries becomes more difficult. A global and more general proof is given of McGlinn's result that in a larger group G whose generators are those of the Poincaré (i.e., inhomogeneous Lorentz) group and an internal group, for certain internal groups the commutativity of the (homogeneous) Lorentz and internal subgroups implies the commutativity of the space-time translation and internal subgroups. In addition, it is shown that in such a group G, which has an internal group for which the commutativity of the Lorentz and internal subgroups does not imply the commutativity of the translation and internal subgroups, the internal multiplets still remain degenerate in mass. (auth)

36335 $Y_1^{*+} - Y_1^{*-}$ MASS DIFFERENCE. Robert Socolow and Sidney Coleman (Harvard Univ., Cambridge, Mass.). Phys. Rev., 135: B1451-2(Sept. 21, 1964).

The $Y_1^{*+} - Y_1^{*-}$ mass difference is calculated, taking account of the contributions from scalar-meson tadpoles, intermediate states involving one Y_1^* and one photon, and intermediate states involving one Σ and one photon. The sum of these yields a mass splitting of between −8.5 and −10.8 Mev. The experimental value is -17 ± 7 Mev. (auth)

36336 METHOD FOR BOSON SPIN DETERMINATION. Peter E. Schlein (CEN, Saclay, France). Phys. Rev., 135: B1453-5(Sept. 21, 1964).

The reaction $K(\pi) + P \to Y + B$ is considered, in which Y is a spin-$\frac{1}{2}$ hyperon and B is a spin-1 boson which decays into two spin-zero bosons. Taking into account the consequences of parity conservation in the production process, the structure of the joint decay distribution of Y and B is defined for arbitrary spin l. It is shown that, at given production angle and total center-of-mass energy, there are $2(2l - 1)$ constraints on the complete set of moments of the joint decay distribution. These constraints may be utilized to test for the compatibility of a set of data with each hypothesized value of l. The structure of the joint decay distribution may also be used to define the forbidden moments, whose absence may be experimentally verified in order to rule out distortion of the distribution due to interference effects, final-state interaction, or experimental biases. The absence of the forbidden moments is also important in cases where the spin of B is known and the data are used to determine the production parameters. (auth)

36337 SIMPLE MODEL FOR STRONG INTERACTIONS. Alan D. Krisch (Cornell Univ., Ithaca, N. Y.). Phys. Rev., 135: B1456-63(Sept. 21, 1964).

A simple model is proposed which relates elastic and inelastic processes in strong interactions. It is assumed that the basic process in strong interactions is meson produc-

tion. The meson fields are calculated from a Klein-Gordon equation using a Gaussian source function. It is assumed that there are three types of strong interactions, whose quanta are, respectively, the π meson, the K meson, and the antibaryon. The sizes of the three corresponding source functions are inversely proportional to the square roots of the masses of the quanta. The three coupling constants are taken to be equal. Elastic scattering is assumed to be the diffraction scattering associated with the inelastic meson-producing processes. Predictions for three phenomena in nucleon-nucleon collisions are obtained: the differential elastic-scattering cross section, the differential cross section for production of particles; the average number of mesons produced as a function of incident energy. The predictions are in good agreement with all experimental data in the multi-Bev region. (auth)

36338 EXPERIMENTAL INVESTIGATION OF V-A IN LEPTONIC LAMBDA DECAY. V. G. Lind, T. O. Binford, M. L. Good, and D. Stern (Univ. of Wisconsin, Madison). Phys. Rev., 135: B1483-6(Sept. 21, 1964). (TID-20539)

Twenty-two $\Lambda \rightarrow p^+ + e^- + \bar{\nu}$ events were observed from $K^0\Lambda^0$ production in hydrogen, for which the lambdas are highly polarized and three events from $K^0\Sigma^0$ production. The 22 polarized events were studied as to the space-time properties of the interaction currents. Assuming vector and axial vector currents, a likelihood fit to the data was used to determine a best value for the ratio and sign of the coupling strengths $k = C_A/C_V$. The data were most consistent with $C_V = -C_A$. Higher order terms in the coupling form factors were considered, but the statistical errors were too large to permit any significant statements concerning them. The branching ratios for Λ_e and Λ_μ decays are reported and are consistent with V–A and muon-electron universality. Finally, the values obtained for k and the Λ_e branching ratio are compared to the theory of N. Cabibbo and seen to be in remarkable agreement. (auth)

36339 EVIDENCE FOR A T = 2 $\Sigma\pi$ RESONANCE. Yu-Li Pan and Robert P. Ely (Univ. of California, Berkeley). Phys. Rev. Letters, 13: 277-80(Aug. 24, 1964).

The production of a $\Sigma\pi$ resonance of isospin–2 in 1.15-Bev/c meson(K^-) interactions with neutrons in carbon in a propane bubble chamber was studied. The reactions of interest were $K^- + n \rightarrow \Sigma^- + \pi^- + \pi^+ +$ recoils and $K^- + n \rightarrow \Sigma^+ + \pi^- + \pi^-$ + recoils. Observational methods and results are discussed. (R.E.U.)

36340 FURTHER SEARCH FOR FRACTIONALLY CHARGED PARTICLES. V. Hagopian (Univ. of Pennsylvania, Philadelphia), W. Selove, R. Ehrlich, E. Leboy, R. Lanza, D. Rahm, and M. Webster. Phys. Rev. Letters, 13: 280-1(Aug. 24, 1964).

An unsuccessful search for particles with positive charges of $\frac{1}{3}$ or $\frac{2}{3}$, lifetimes greater than 10^{-7} sec, and masses as high as 2.5 or 3.0 Bev is reported. An unseparated beam of positive secondaries (mesons(π^+) and protons) from the Brookhaven AGS was directed into a liquid-hydrogen bubble chamber, and 10,000 pictures were analyzed. Reasons are given for concluding that no fractionally charged particles with mass to 2.5 Bev are produced in proton-nucleus collisions at 30 Bev. (R.E.U.)

36341 LOW-MOMENTUM Λ-p ELASTIC SCATTERING CROSS SECTIONS. B. Sechi-Zorn, R. A. Burnstein, T. B. Day, B. Kehoe, and G. A. Snow (Univ. of Maryland, College Park). Phys. Rev. Letters, 13: 282-4(Aug. 24, 1964).

A study of Λ-p elastic scattering at incident Λ momenta of 120 to 400 Mev/c is reported. The hyperons were produced in a hydrogen bubble chamber exposed to mesons (K^-): 75 scattering events were analyzed. (R.E.U.)

36342 EXAMPLE OF $K_{\mu 4}$ DECAY IN EMULSION. Douglas E. Greiner, W. Z. Osborne, and Walter H. Barkas (Univ. of California, Berkeley). Phys. Rev. Letters, 13: 284-5(Aug. 24, 1964).

Emulsion data for meson (K^+) decays (identified as $K^+ \rightarrow \pi^+ + \pi^- + \mu^+ + \nu_\mu$) are given. The direction of each prong was measured using a digitized microscope, and an IBM 7094 was used to calculate the deviations from coplanarity of the prongs. The events that violated coplanarity were examined in greater detail. (R.E.U.)

36343 CP VIOLATION IN K^0 DECAYS. R. G. Sachs (Argonne National Lab., Ill.). Phys. Rev. Letters, 13: 286-8(Aug. 24, 1964).

The violation of CP invariance in $K_2^0 \rightarrow 2\pi$ is suggested to be an indirect manifestation of a "maximal" CP violation in the leptonic interactions of the K^0 meson. For this mechanism to be true, the $\Delta S = -\Delta Q$ interaction is out of phase with the $\Delta S = \Delta Q$ interaction by $\frac{1}{2}\pi$. (R.E.U.)

36344 NEUTRINO PRODUCTION OF MUON PAIRS THROUGH A DIRECT FOUR-FERMION COUPLING. G. N. Stanciu (Univ. of Michigan, Ann Arbor). Phys. Rev. Letters, 13: 288-91(Aug. 24, 1964).

The production of meson(μ) pairs by muon-neutrinos by means of a direct four-fermion coupling mechanism is discussed. Exact calculations are presented for the coherent production, $\nu_\mu + Z \rightarrow \nu_\mu + \mu^+ + \mu^- + Z$ (coh) and the production from free protons, $\nu_\mu + p \rightarrow \nu_\mu + \mu^+ + \mu^- + p$. (R.E.U.)

36345 SIGMA LEPTONIC DECAYS AND CABIBBO'S THEORY OF LEPTONIC DECAY. W. Willis (Brookhaven National Lab., Upton, N. Y.), H. Courant, H. Filthuth, et al. Phys. Rev. Letters, 13: 291-5(Aug. 24, 1964).

Results are given for Σ^+ and Σ^- leptonic decays for $\Delta S/\Delta Q = +1$, $\Delta S = 0$, and $\Delta S/\Delta Q = -1$, and are compared with Cabibbo's theory of weak interactions. (R.E.U.)

36346 NATURALLY OCCURRING ZERO-MASS PARTICLES AND BROKEN SYMMETRIES. G. S. Guralnik (Imperial Coll. of Science and Tech., London). Phys. Rev. Letters, 13: 295-8(Aug. 24, 1964).

It is shown that there is a class of theories in which it is possible to construct exactly the state $|\eta,0\rangle$, satisfying $\langle 0,\eta|\varphi(x)|\eta,0\rangle = C(\eta)$, from the state $|0\rangle$, for which $\langle 0|\varphi|0\rangle = 0$, where η is a numerical parameter introduced to distinguish explicitly the broken-symmetry vacuum states from the usual vacuum states $|0\rangle$, for which the expectation value of $\varphi(x)$ vanishes. (R.E.U.)

36347 SPIN AND UNITARY SPIN INDEPENDENCE OF STRONG INTERACTIONS. F. Guersey, A. Pais, and L. A. Radicati (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. Letters, 13: 299-301(Aug. 24, 1964).

The consequences of the assumption that strong interactions are spin and unitary spin (F-spin) independent are considered. The meson-baryon vertex and some subgroups of SU(6) are discussed. (R.E.U.)

36348 SEARCH FOR NEUTRAL LEPTONIC CURRENTS IN K^+ DECAY. U. Camerini (Univ. of Wisconsin, Madison), D. Cline, W. F. Fry, and W. M. Powell. Phys. Rev. Letters, 13: 318-21(Aug. 31, 1964).

In order to look for evidence of neutral currents in strangeness-changing interactions, the possible decay mode $K^+ \rightarrow \pi^+ + e^+ + e^-$ was searched for in a sample of 1.7×10^6 stopped-K^+ decays. The mesons (K^+) were

stopped in a heavy-liquid bubble chamber filled with C_3F_8. No unambiguous events were found corresponding to the decay mode. (C.E.S.)

36349 BROKEN SYMMETRY AND THE MASS OF GAUGE VECTOR MESONS. F. Englert and R. Brout (Université Libre, Brussels). Phys. Rev. Letters, 13: 321-3(Aug. 31, 1964).

It is shown that in certain cases gauge vector mesons acquire mass through interaction when the vacuum is degenerate (broken symmetry) with respect to a compact Lie group. (C.E.S.)

36350 THE PROBLEM ON THE UP-DOWN ASYMMETRIES OF STRANGE PARTICLE DECAYS. Che-tzhu Chin and Ning Hu. Wu Li Hsueh Pao, 20: 374-7(Apr. 1964). (In Chinese)

36351 ELASTIC SCATTERING OF 4-Gev/c π^- MESONS BY PROTONS. N. Dalkhazhav, A. I. Zlateva, Z. F. Korbel, P. K. Markov, T. S. Todorov, D. Tuvdendorzh, Kh. M. Chernev, and M. G. Shafranova (Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Eksperim. i Teor. Fiz., 47: 12-15(July 1964). (In Russian)

Elastic π^-p scattering at a momentum 4.0 Bev/c is studied with photographic emulsions in the transferred 4-momentum region $0.0046 < |t| \leq 0.115$ [Bev/c]^2. 222 elastic scattering events were identified. The ratio of the real part of the scattering amplitude to the imaginary is $\alpha = -0.01 \pm 0.30$. The total elastic scattering cross section $\sigma_{el} = 5.9 \pm 0.5$ mb. The differential cross section slope parameter $A = 7.5 \pm 0.6$ [Bev/c]$^{-2}$ for $0.01 < |t| < 0.2$ [Bev/c]^2. (auth)

36352 ANGULAR DISTRIBUTIONS OF SECONDARY PARTICLES FROM pN COLLISIONS AT 24 Bev. Sh. Abduzhamilov, S. A. Azimov, L. P. Chernova, G. M. Chernov, and V. M. Chudakov (Inst. of Nuclear Physics, Academy of Sciences, Uzbek SSR). Zh. Eksperim. i Teor. Fiz., 47: 24-9(July 1964). (In Russian)

The dispersion analysis statistical method (F criterion) is employed for verifying the assumption that the emission angles of secondary particles in inelastic pN-interactions involving primary protons of equal energy E and equal numbers of secondary charged particles n are independent. The experimental values of F for pN interactions at E = 24 Bev and n = 4–9 do not agree with this assumption and indicate that in the lab system the angular distributions are different, a fact which cannot be explained by the effect of the law of conservation of momentum in head-on collisions and which is related to the mechanism of particle production in peripheral interactions. This nonuniformity is similar to the asymmetric emission of particles in the cms in NN collisions previously observed at $\sim 10^{11}$ ev. Peripheral interactions at E = 24 Bev continue to play a large role up to multiplicities n = 9. (auth)

36353 PION BETA DECAY. A. F. Dunaitsev, V. I. Petrukhin, Yu. D. Prokoshkin, and V. I. Rykalin (Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Eksperim. i Teor. Fiz., 47: 84-91(July 1964). (In Russian)

Pion β-decay events were recorded with Cherenkov spectrometers. The relative probability for the decay is found to be $\lambda = (1.1 \pm 0.2) \cdot 10^{-3}$ which confirms the hypothesis of conservation of vector current. The values of the constants G and G_β characterizing pion and nucleon β decay are equal: $G = (1.03 \pm 0.11)G_\beta$. The energy spectrum of positrons produced in β decay of pions is in agreement with that calculated on basis of the hypothesis of conservations of vector current. (auth)

36354 INELASTIC INTERACTION OF 3.5-Bev/c π^- MESONS WITH PROTONS. M. S. Ainutdinov, S. M. Zombkovskii, Ya. M. Selektor, and V. N. Shulyachenko (Inst. of Theoretical and Experimental Physics, Academy of Sciences, USSR). Zh. Eksperim. i Teor. Fiz., 47: 100-6 (July 1964). (In Russian)

Inelastic interactions of 3.5-Bev/c π^- mesons with protons were studied with a liquid hydrogen chamber of 25 cm diameter. The angular and momentum distributions of the secondary particles are presented. Two resonances were observed for the $\pi^- + p \rightarrow \pi^- + \pi^+ + n$ reaction: one for a mass ~750 (ρ^0 meson) and another for ~1250 Mev (f^0 meson). Simultaneous production of a ρ^0 meson and isobars with masses >1300 Mev is suggested. (auth)

36355 ON THE EXISTENCE OF A ZERO-MASS PSEUDOSCALAR MESON. Nguyen Van-Hieu (Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Eksperim. i Teor. Fiz., 47: 116-25(July 1964). (In Russian)

Some consequences of the existence of a pseudoscalar zero mass meson are considered: corrections to the anomalous magnetic moment of the lepton, to the Lamb shift of the hydrogen atom energy levels, to the energy level shift of the para- and ortho-positronium ground states. The effective static potential of fermion interaction at large distances and emission of long wave mesons are also determined. Some possibilities of observing the particle are discussed. (auth)

36356 ON THE CHOICE OF INVARIANT VARIABLES FOR THE AMPLITUDES OF PARTICLE PRODUCTION PROCESSES. A. Frenkel. Zh. Eksperim. i Teor. Fiz., 47: 221-3(July 1964). (In Russian)

It is shown that in the amplitude for transition of two particles into (n – 2) particles (in the n-tail), it is possible to choose in a simple manner as independent variables 3n – 10 double invariants in such a way that all other invariants can be expressed in terms of them by second order equations. (auth)

36357 EFFECT OF FORM FACTORS ON THE RELATIVE PROBABILITY FOR LEPTON DECAYS OF HYPERONS. V. M. Shekhter (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Eksperim. i Teor. Fiz., 47: 262-9(July 1964). (In Russian)

Irrespective of the magnitude of the weak interaction constants in the absence of form factors, the theory predicts a ratio of the μ-meson to electron decay probabilities of hyperons which should be correct to ~1%. The difference between this ratio and the theoretical value characterizes the role of decay interaction form factors and is probably not greater than 30%. For the ratio of the $\Sigma^- \rightarrow \Lambda + e^- + \nu$ and $\Sigma^+ \rightarrow \Lambda + e^+ + \nu$ decays the theory predicts a value 1.67 ± 0.06. (auth)

36358 $K \rightarrow 3\pi$ DECAY AND THE INTERACTION BETWEEN π MESONS AT LOW ENERGIES. V. V. Anisovich (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Eksperim. i Teor. Fiz., 47: 240-7(July 1964). (In Russian)

The Skornyakov–Ter-Martirosian integral equation for the $K \rightarrow 3\pi$-decay is solved by an iteration procedure for the case when a_0 is large and $a_2 = 0$ (a_T is the scattering length for mesons in a state with an isotropic spin T). The energy and angular distributions obtained in this way for the $K^\pm \rightarrow 2\pi^\pm + \pi^\mp$ reactions are compared with experimental data for $a_0 = 1,2,3$. It is found that the experimental data can be satisfactorily described by the theoretical curves only for $a_0 = 1$. This should indicate that a_0 is of the order of unity or smaller. It was previously shown

that the experimental results on $K \rightarrow 3\pi$-decay are consistent with the assumption that a_0 is small. (auth)

36359 WEAK η MESON DECAYS. L. B. Okun and I. S. Tsukerman. Zh. Eksperim. i Teor. Fiz., 47: 349-51(July 1964). (In Russian)

A measurement of the probabilities of weak $\eta \rightarrow \pi ev$ and $\eta \rightarrow 2\pi ev$ decays can be used for verifying the accuracy with which the vector current is conserved and possesses a definite G-parity. Unfortunately the expected relative probability for weak η-meson decays is very small ($\sim 10^{-10}$ for the $\eta \rightarrow 2\pi ev$ decay and $\sim 10^{-13}$ for the $\eta \rightarrow \pi ev$ decay). (auth)

36360 BROKEN ISOTOPIC SYMMETRY OF WEAK INTERACTIONS. E. M. Lipmanov (Volograd State Pedagogical Inst., USSR). Zh. Eksperim. i Teor. Fiz., 47: 360-5(July 1964). (In Russian)

A model for weak interactions between elementary particles is formulated in which isotopic symmetry of the interaction between hadron currents and intermediate bosons is violated only by such terms in the free field lagrangian which have the form of non-diagonal mass of the intermediate bosons. The $\Delta S < 2$ and $\Delta|T| = 1/2$ rules are some of the basic assumptions underlying the model. Violation of universality of the four-fermion interaction constant with change of strangeness is a natural consequence of the model. (auth)

36361 STUDIES OF $\pi^- + p \rightarrow 2\pi^- + 2\pi^+ + k\pi^0 + n$ REACTION AT THE INITIAL 3.5 Bev/c π-MESON MOMENTUM. M. S. Ainutdinov, S. M. Zombkovskii, Ya. M. Selektor, and V. N. Shulyachenko (Inst. of Theoretical and Experimental Physics, Erevan). Zh. Eksperim. i Teor. Fiz., 47: 383-5(July 1964). (In Russian)

A hydrogen bubble chamber was exposed to a meson(π^-) beam at 3.5 Bev/c to search for a 4 meson(π) resonance in the $\pi^- + p \rightarrow 2\pi^- + 2\pi^+ + k\pi^0 + n$ interaction. The mass distributions were measured, and a resonance was found in the mass interval of 1100 to 1300 Mev. It could not be determined if this event was a 4 meson(π) resonance on the 4-particle decay of the meson(B) (a π-ω resonance at $\sim$1250 Mev). (C.E.S.)

36362 THE BETA DECAY OF THE PION. P. Depommier (Université, Grenoble, France). p.317-22 of "Selected Topics in Nuclear Spectroscopy." New York, John Wiley and Sons, 1964.

The validity of the conserved vector current theory was investigated by measuring the branching ratio $\pi^+ \rightarrow \pi^0 + e^+ + \nu / \pi^+ \rightarrow \mu^+ + \nu$. A value of $1.15 \pm 0.22 \times 10^{-8}$ was obtained, compared to the value $1.06 \pm 0.03 \times 10^{-8}$ predicted by the theory. (D.C.W.)

36363 THE RELATIVISTIC INTERACTION OF CLASSICAL PARTICLES WITH CHARGE, INTRINSIC SPIN AND MAGNETIC MOMENT. Jon Albert Schlosser. Thesis, Austin, Tex., Univ. of Texas, 1963. 104p.

A rigorous relativistic treatment of the interaction of charged particles with intrinsic spin and magnetic moment is carried out. Quantum mechanical effects are not taken into account, although an elementary quantization procedure is proposed for future study. The treatment includes the determination of rigorous equations of motion and conservation laws of momentum, energy, and angular momentum. The equations of motion for each particle in the fields of the remaining particles are obtained from a single principle of stationary action wherein the interactions are time symmetric. The conservation laws are obtained from the action when variations are considered that are infinitesimal Lorentz transformations. The purpose of this rigorous relativistic treatment is to investigate possible highly relativistic Bohr quantized stationary circular motions of pairs of particles with charge, intrinsic spin and magnetic moment. In such states the principal interaction may involve the magnetic moments and therefore the usual perturbation treatments would not be useful. Unquantized simple circular solutions of the rigorous relativistic equations of motion are found to exist and the quantization of these motions will be considered in a later paper. (Dissertation Abstr., 24: No. 12, Pt. I (June 1964))

Field Theory and Quantum Mechanics

36364 (ARL-64-79) REDUCTION OF FERMION OPERATORS BY LITTLE GROUP TECHNIQUE. Scientific Report No. 6. I. V. V. Raghavacharyulu (Uppsala Univ.). Dec. 15, 1963. Contract AF61(052)-701. 11p. (AD-436703)

It is shown that the different representations of the Dirac operators, which are used in physical applications, could be obtained as representations of a group, called Dirac group, by the little group technique. Further, this approach to these operators reduces the important theorems on their matrix representations to the well-known theorems on the representations of the groups. This analysis is further extended to the fermion annihilation and creation operators through an extended Dirac group to obtain their well-known matrix representations. (auth)

36365 THE NEWTONIAN GRAVITATIONAL THEORY AS A RIGOROUS LIMITING CASE OF THE GENERAL RELATIVITY THEORY. G. Dautcourt (Institut für Reine Mathematik, Berlin). Acta Phys. Polon., 25: 637-46(May 1964). (In German)

In order to derive from general relativity the four-dimensional formulation of the Newtonian gravitational theory given by Friedrichs and Trautman two conditions must be assumed: there exists a set of contravariant Einsteinian fields $g^{\mu\nu}(\epsilon)$ tending for $\epsilon \rightarrow 0$ towards a degenerate metric $g_0^{\mu\nu}$ of rank 3; and the inner metric of the hypersurfaces t = const is independent from the Newtonian time t. (auth)

36366 STATIONARY SOLUTION OF DIRAC EQUATION IN GENERAL RELATIVITY. Józef Namysłowski (Jagellonian Univ., Krakow). Acta Phys. Polon., 25: 741-7 (May 1964).

The six conditions on Vierbein field that enable the x-dependence of each element of matrices γ^μ to be determined are discussed in the case of metric, which admits a continuous group of motion. These conditions are also used for finding out the Schroedinger representation of the Dirac equation. (auth)

36367 PARTICLE MOTION IN THE EQUATORIAL PLANE. Vincent L. Pisacane (Johns Hopkins Univ., Silver Spring, Md.). AIAA (Am. Inst. Aeron. Astronaut.) J., 2: 1361-4(Aug. 1964).

The bound motion of charged particles in the equatorial plane of a concentric gravitational and dipole magnetic field was analyzed. The exact evaluation of the angular drift, angular drift velocity, and period was reduced to the evaluation of the complete normal elliptic integrals. A first-order approximation to the particle trajectory gives more tractable results and a better approximation to the angular drift velocity than that of the guiding center theory. (auth)

36368 A GENERALIZATION OF THE SCHROEDINGER EQUATION FOR THE CASE OF NON-BOUND MOVEMENT OF PARTICLES. Assène Datzeff. Compt. Rend., 258: 6354-7(June 29, 1964). (In French)

The new interpretation of quantum mechanics (J. Phys. Rad., 23: 241(1962)) is analyzed to determine if the new and orthodox interpretations correspond. It is shown that quantum mechanics based on the theory of linear operators probably describes only a first approximation of reality valid for small particle densities. (J.S.R.)

36369 FOUNDATIONS OF QUANTUM MECHANICS. P. A. M. Dirac (Cambridge Univ., Eng.). Nature, 203: 115-16(July 11, 1964).

The Heisenberg and Schroedinger equations are compared, and it is shown that for an infinite number of degrees of freedom the Schroedinger picture of quantum mechanics is inadequate and that the Heisenberg picture has more fundamental validity. (C.E.S.)

36370 CLASSICAL EXAMPLE OF ESSENTIALLY SINGULAR COUPLING. A. Pais (Rockefeller Inst., New York). Nucl. Phys., 57: 96-9(Aug. 1964).

An example in classical field theory is given of a case where it is impossible to expand solutions in powers of a coupling constant, however small this constant may be. The reason is that the interaction is essentially singular at the source. (auth)

36371 MICRO- AND MACROMEASUREMENTS. H. J. Groenewold (Rijksuniversiteit, Groningen, Netherlands). Nucl. Phys., 57: 112-33(Aug. 1964).

In the quantal measurement of a microsystem the amplification to an irreversible recording in a macropart of the measuring instrument is essential. The record has to be read by classical means. The description of the measuring process requires the switching over between the quantal and classical description of the macropart. The formulation of this switching between the two complementary descriptions requires in its turn a theory of quantal and classical measurements. Some, mainly statistical, aspects of these two interwoven problems are discussed, in particular the ways in which correlations get lost. (auth)

36372 NON-LOCAL QUANTUM ELECTRODYNAMICS. Maurice Lévy (Université, Paris). Nucl. Phys., 57: 152-90 (Aug. 1964).

A gage invariant non-local form of quantum electrodynamics is constructed by introducing, in the interaction Lagrangian, averages of the Dirac field operators over time-like paths. It is shown that this theory leads to convergent results to every order of perturbation theory. Observable quantities are averaged subsequently over all possible time-like paths. The theory contains a finite renormalization of the photon mass which does not conflict with gage invariance. The experimental requirement that the physical mass of the photon should vanish corresponds to an additional condition to be imposed to the parameters of the theory. (auth)

36373 ROTATIONS AND LORENTZ TRANSFORMATIONS. Peter Rastall (Univ. of Texas, Austin). Nucl. Phys., 57: 191-207(Aug. 1964).

Any complex three-dimensional rotation is determined by a complex vector and by a complex angle of rotation. New, short proofs are given of the homomorphisms between the three-dimensional complex rotation group, the group of unimodular quaternions (or unimodular 2×2 matrices) and the restricted Lorentz group. A correspondence is established between certain complex three-dimensional rotation vectors and two-dimensional subspaces of Lorentz vectors. The two-dimensional subspaces which are invariant under a given restricted Lorentz transformation are shown to be determined by those eigenvectors of the corresponding three-dimensional rotation matrix which belong to real eigenvalues. For non-null restricted Lorentz transformations this leads to a proof of Synge's theorem. (auth)

36374 A GENERALIZED SUSCEPTIBILITY AND HARTREE-FOCK APPROACH TO THE MANY-BODY PROBLEM. V. J. Emery (Univ. of California, Berkeley). Nucl. Phys., 57: 303-18(Aug. 1964).

It is shown that the two-particle density matrix and hence the grand partition function for a many-body system may be obtained from generalized susceptibilities which specify the linear response of the system to external perturbations which excite oscillations in the relative motion of pairs of particles. The susceptibilities are calculated in a generalized time-dependent Hartree-Fock approximation which is a generalization of the BCS theory of superconductivity or the Bogolyubov, Brueckner-Sawada theory of a Bose system. The partition function obtained in this manner is equivalent to a sum of ladder graphs for a normal Fermion system and to a sum of quasiparticle ladder graphs for a superconductive Fermion system; unphysical poles in the reaction matrix do not arise. The method is extended to give a finite temperature version of Brueckner's theory. Equivalent results are derived for systems of bosons. (auth)

36375 GRAVITATIONAL RADIATION IN FIRST APPROXIMATION. A. Papapetrou (Institut Henri Poincaré, Paris). Nucl. Phys., 57: 319-29(Aug. 1964). (In French)

A material system containing particles with arbitrary velocities is considered in the first approximation of general relativity, and the asymptotic form of the gravitational pseudotensor in the zone of radiation is discussed. The energy of the gravitational radiation is shown to be reducible to a positive-definite expression. An application to the case of a simplified radiating system is briefly described and the amount of radiated gravitational energy compared to the corresponding electromagnetic energy. (auth)

36376 THE FOUR-MOMENTUM OF AN INSULAR SYSTEM IN GENERAL RELATIVITY. C. Moeller (Universitet, Copenhagen and NORDITA, Copenhagen). Nucl. Phys., 57: 330-8(Aug. 1964).

It is shown that the total four-momentum of a non-radiative insular system in the tetrad formulation of general relativity is a free 4-vector under arbitrary space-time transformations, in complete accordance with the general principle of relativity. (auth)

36377 ON AN ANALOGOUS FORMULATION OF MAXWELL EQUATIONS AND THE DIRAC EQUATIONS AT ZERO MASS. J. Serpe (Université, Liège). Nucl. Phys., 57: 351-5(Aug. 1964). (In French)

A formulation of Maxwell equations, analogous to Moses formulation, but using true Dirac matrices, is considered. It is shown how the transformation of the wave function ensuring the invariance of Maxwell theory for the Lorentz group is related to the transformation of a Dirac spinor. (auth)

36378 ON THE CENTRAL EXTENSIONS OF CONNECTED INHOMOGENEOUS LORENTZ GROUP. Louis Michel (Institut des Hautes Études Scientifiques, Bures-sur-Yvette, France). Nucl. Phys., 57: 356-86(Aug. 1964). (In French)

The group of inner automorphism of $SL(2,C)$ is L_0, the

connected homogeneous Lorentz group; P_0 denotes the inhomogeneous group of L_0. The following mathematical results are proved for the group $H^2(G,A)$ of central extensions of the group G by the abelian group A, when G is one of the three groups SL(2,C), L_0, P_0 considered as discrete groups only. For all A, $H^2(P_0,A) = H^2(L_0,A)$. If K is a reduced group (no divisible subgroups) $H^2(SL(2C),K) = 0$, hence $H^2(P_0,K) = {}_2K$. Let Aut C be the group of algebraic automorphisms of the complex field. Aut SL(2,C) = Aut L_0 = semi-direct product $L_0 \cdot$ Aut C. If $A^{\text{Aut C}} = A$, $H^2(SL(2,C),A)^{\text{Aut C}} = 0$, thence $H^2(L_0,A)^{\text{Aut C}} = {}_2A$. (auth)

36379 ROLE FOR A FUNDAMENTAL EQUATION IN FUNDAMENTAL THEORY OF MATTER. E. Van Der Spuy (Atomic Energy Board, Pelindaba, South Africa). Nucl. Phys., 58: 353-73(Sept. 1964).

Starting from a fundamental spinor field equation of the type $i\hat{\nabla}\psi(x) = l^2T(\bar{\psi}(x)O^i q\psi(x))O_i \cdot q\psi(x)$, equations relating τ-functions of successive orders may be deduced. Using the lowest order equation of the latter set, and a minimal representation of the fourth order τ-functions involved in terms of the relevant baryon scattering amplitudes, a set of algebraic equations is obtained in terms of the masses of the basic baryon fields and their coupling constants to the exchanged mesons concerned. On the basis of the expectation that the algebraic equations would yield a threefold multiplicity for the positive basic baryon masses, and the belief that the fundamental equation should have as many basic fields as the multiplicity of its basic mass solutions, three basic baryon fields are used. Then q is an eight component vector of 3×3 matrices giving a formally symmetric self-interaction in the fundamental equation. It is considered possible, nevertheless, that the basic masses may be different due to the fact that the coupling constants as determined by the mentioned algebraic equations depend on the mass ratios in general. The implications of the formal symmetry of the fundamental equation and the possible asymmetry of the solution for the multiplicity of the vacuum states are discussed. Corresponding to the γ^5 invariance of the fundamental equation at least a corresponding multiplicity of leptonic mass solutions is predicted. The scalar parts of the baryon scattering amplitudes use a double dispersion integral representation of a Regge type amplitude in the integration of the τ-function equation. The importance of the oscillatory behavior of the Regge type amplitude for the elimination of the usual type of divergences in the Feynman integrations involved is discussed. (auth)

36380 THE GROUND-STATE THREE-BODY CORRELATION FUNCTION IN A DILUTE BOSON GAS WITH HARD-SPHERE INTERACTION. P. Bocchieri and C. A. Orzalesi (Universita, Pavia, Italy and Istituto Nazionale di Fisica Nucleare, Pavia, Italy). Nuovo Cimento (10), 33: 184-92(July 1, 1964).

The three-body correlation function is evaluated for the ground state of a dilute boson gas with hard-sphere interaction and the validity of the superposition approximation $D(r_{12},r_{13},r_{23}) \approx D(r_{12})D(r_{13})D(r_{23})$ is discussed. The main result is that the superposition approximation holds only when all the relative co-ordinates are much greater than the correlation length $r_0 = (8\pi a\rho)^{-\frac{1}{2}}$ (a and ρ are the hard sphere radius and number density of the gas, respectively). One also finds that the system shows unexpected long-distance correlations since one has $D(r_{12},\infty,\infty) \neq D(r_{12})$. (auth)

36381 ASYMPTOTIC BEHAVIOR OF A FUNCTION EXPRESSED THROUGH A DISPERSION INTEGRAL. L. Lanz and G. M. Prosperi (Universita, Milan and Istituto Nazionale di Fisica Nucleare, Milan). Nuovo Cimento (10), 33: 201-10 (July 1, 1964).

Given a function f(z) expressed through a dispersion integral with a spectral function $\rho(\xi)$, a theorem is established which provides an asymptotic bound for f(z), once given asymptotic bounds to $\rho(\xi)$ and $\rho'(\xi)$. The result is applied to the discussion of the asymptotic behavior of the partial wave and the total scattering amplitudes. (auth)

36382 A COMMENT ON THE NEUTRINO-THEORY OF LIGHT. B. Ferretti (Università, Bologna). Nuovo Cimento (10), 33: 264-6(July 1, 1964).

Problems in the neutrino theory of light that arise when the photon is considered as arising from the excitation of a system of two neutrinos are discussed. (C.E.S.)

36383 COLLINEAR PARTICLES AND BONDI DIPOLES IN GENERAL RELATIVITY. W. Israel and K. A. Khan (Univ. of Alberta, Edmonton, Can.). Nuovo Cimento (10), 33: 331-44(July 16, 1964).

A static vacuum line-element is derived which represents the field of a collinear set of spherically symmetric masses. A limiting process applied to this line-element yields an explicit global solution of a problem first considered by Bondi, the field of two symmetrically placed mass-dipoles moving in radially opposite directions. (auth)

36384 THE CLOCK PARADOX IN GENERAL RELATIVITY. R. H. Boyer (Univ. of Liverpool). Nuovo Cimento (10), 33: 345-51(July 16, 1964).

The clock paradox of special relativity is studied in the context of general relativity. Reference is made to an example of Tangherlini showing that the prediction of special relativity is not always valid in the general theory. The reasons for this are examined using the methods of the calculus of variations. The significance of conjugate points is discussed. (auth)

36385 COMPLEX ANGULAR MOMENTUM AND THREE-DIMENSIONAL LORENTZ GROUP. L. Sertorio and M. Toller (Istituto Nazionale di Fisica Nucleare, Rome). Nuovo Cimento (10), 33: 413-33(July 16, 1964).

The integral equation for the scattering amplitude in field theory is investigated for the case in which the fixed parameter is the momentum transfer. Its symmetry under a three-dimensional Lorentz group is used to reduce the number of its variables and in this process two parameters, l and τ, are introduced, corresponding to the complex angular momentum and to the signature. As to every complex l corresponds an irreducible representation of the three-dimensional Lorentz group, a satisfying group-theoretical justification of the complex angular momentum is obtained. Formulas for the high-energy scattering amplitude are derived, which resemble the Watson-Sommerfeld formula modified by Mandelstam. The connection of the equations with the analytically continued Bethe-Salpeter equation is clarified. (auth)

36386 ASYMPTOTIC BEHAVIOUR OF THE VERTEX FUNCTION IN FIELD THEORY. M. Cassandro and M. Cini (Università, Rome and Istituto Nazionale di Fisica Nucleare, Rome). Phys. Letters, 11: 159-60(July 15, 1964).

An attempt is made to derive an asymptotic limit of the vertex when the fermion external lines are on shell and the modulus of the boson momentum tends to infinity. Spinor electrodynamics with massive photons are used. (C.E.S.)

36387 DOES ZERO BARE MASS FOR THE ELECTRON ENTAIL FINITE MASS FOR THE PHOTON? Y. Frishman and A. Katz (Weizmann Inst. of Science, Rehovoth, Israel). Phys. Letters, 11: 172-4(July 15, 1964).

Dyson's equation for the electron propagator in which the bare mass was set to zero is investigated. A finite but arbitrarily small mass for the photon is considered. (C.E.S.)

36388 BIREFRINGENCE OF THE VACUUM. James J. Klein and B. P. Nigam (State Univ. of New York, Buffalo). Phys. Rev., 135: B1279-?(Sept. 7, 1964).

It is known that Maxwell's equations become nonlinear if the effect of virtual electron-positron pair creation is included. The vacuum, thus behaving like a polarizable continuum, is shown to exhibit the phenomenon of birefringence. (auth)

36389 QUANTUM STATISTICS OF IDEAL GASES IN TWO DIMENSIONS. Robert M. May (Univ. of Sydney). Phys. Rev., 135: A1515-18(Sept. 14, 1964).

It is shown that in two dimensions the specific heat $C_V(T,N)$ for an ideal gas of Fermi particles is identical with that for an ideal Bose gas for all T and N. This is true despite the great difference in the distribution functions of the two systems at low temperatures. To shed further light on this identity, the quantum statistics of ideal gases are investigated treating the number of dimensions as a continuous variable: n = 2 is seen to be a special case. In the extreme relativistic region, the analogous special case is n = 1. (auth)

36390 CONNECTION BETWEEN THE ASYMPTOTIC BEHAVIOR AND THE SIGN OF THE DISCONTINUITY IN ONE-DIMENSIONAL DISPERSION RELATIONS. Y. S. Jin and A. Martin (Inst. for Advanced Study, Princeton, N. J.). Phys. Rev., 135: B1369-74(Sept. 21, 1964).

Starting from one-dimensional dispersion relations (either fixed-transfer or partial-wave), information on the sign of absorptive part which follows from unitarity, and in some cases analyticity in the Mandelstam ellipse in the t plane and polynomial boundedness, various consequences of physical interest are derived, e.g., a high-energy lower bound on the forward scattering amplitude, the minimum fluctuation of the sign of the discontinuity across the left-hand cut in the partial-wave dispersion relations, etc. In the derivations, the positiveness of the absorptive part plays an essential role by allowing us to construct a Herglotz function which has a well-known asymptotic behavior. (auth)

36391 NUMBER OF SUBTRACTIONS IN FIXED-TRANSFER DISPERSION RELATIONS. Y. S. Jin and A. Martin (Inst. for Advanced Study, Princeton, N. J.). Phys. Rev., 135: B1375-7(Sept. 21, 1964).

Assuming the minimal requirements necessary to derive the Froissart bound, the number of subtractions for the fixed-momentum-transfer dispersion relation in the unphysical region $0 < t < 4\mu^2$ turns out to be 2. In the proof, the positiveness of all the derivatives of absorptive part with respect to t at t = 0 is used. Physical implications and applications of this result are briefly discussed. (auth)

36392 HIGH-ENERGY BEHAVIOR OF THE SCATTERING AMPLITUDE FOR NEGATIVE MOMENTUM TRANSFER. S. W. MacDowell (Inst. for Advanced Study, Princeton N. J.). Phys. Rev., 135: B1378-80(Sept. 21, 1964).

The high-energy behavior of the scattering amplitude is investigated in the real negative region of momentum transfers $-t$, for t below the threshold $t = 4m^2$ of the crossed channel. If one assumes the existence of bound states in the crossed t channel with angular momenta larger than one, one can show that the high-energy scattering amplitude behaves as if dominated by a Regge trajectory $\alpha(t)$ of even signature and the quantum numbers of the vacuum. It is shown that $\alpha(t)$ is continuous in the open interval $(0,4m^2)$, and an upper bound for $\alpha(t)$ is given under the assumption of analyticity in the domain $\mathrm{Re}\,t^{\frac{1}{2}} \geq 2m$. (auth)

36393 LOCATIONS OF LANDAU SINGULARITIES. Richard E. Norton (Univ. of California, Los Angeles). Phys. Rev., 135: B1381-8(Sept. 21, 1964).

It is shown for the third-order triangle and the fourth-order box Feynman diagrams that singularities exist on the physical boundaries of the amplitudes if, and only if, the external momenta are such as to allow the reactions to actually proceed with real intermediate particles. If, furthermore, the information concerning the locations and appropriate branches of singularities implied by this principle is combined with the requirement that discontinuities be given by Cutkosky's rules, the amplitudes are uniquely determined. (auth)

36394 MODIFIED PERTURBATION METHOD FOR SPINOR ELECTRODYNAMICS. J. Strathdee (Imperial Coll. of Science and Tech., London). Phys. Rev., 135: B1428-9(Sept. 21, 1964).

The zeroth approximation of a modified perturbation theory of photons and electrons is constructed by the application of Salam's gauge technique. (auth)

36395 NORMALIZATION OF BETHE-SALPETER WAVE FUNCTIONS AND BOOTSTRAP EQUATIONS. R. E. Cutkosky and M. Leon (Carnegie Inst. of Tech., Pittsburgh). Phys. Rev., 135: B1445-6(Sept. 21, 1964).

The normalization condition for Bethe-Salpeter wave functions is derived directly from the integral equation for the Green's function. The result agrees with, but is more general than the usual one which requires the existence of a conserved current. An application is given to the derivation of bootstrap equations. (auth)

36396 UPPER BOUNDS FOR THE SCATTERING AMPLITUDE AT HIGH ENERGY. T. Kinoshita (Cornell Univ., Ithaca, N. Y. and CERN, Geneva), J. J. Loeffel, and A. Martin. Phys. Rev., 135: B1464-82(Sept. 21, 1964).

Constraints imposed by unitarity and analyticity on the high-energy behavior of scattering amplitudes are studied in detail. The Froissart bound at nonforward (and nonbackward) angle is improved by two different methods: One is based on the analyticity in complex $\cos\theta$ plane, and the other on the analyticity of the partial-wave amplitude in the complex angular-momentum plane. It is also shown that the Froissart bound at $\theta = 0$ or π cannot be improved insofar as one does not impose restrictions on the scattering amplitude other than unitarity and the analyticity in the $\cos\theta$ plane. The scattering of particles with spin is discussed briefly. (auth)

36397 MACROSCOPIC BODIES IN QUANTUM THEORY. Asher Peres and Nathan Rosen (Israel Inst. of Tech., Haifa). Phys. Rev., 135: B1486-?(Sept. 21, 1964).

It is shown that if the wave function of a massive body is $\psi = \Sigma c_n \psi_n$, where the ψ_n are macroscopically distinguishable states, then the observation of interferences between the various ψ_n requires inconceivable laboratory conditions (e.g., the experiment may last longer than the lifetime of the universe). It is therefore proposed to interpret $\Sigma c_n \psi_n$ as a mixture of states, and not as a superposition. This new interpretation of wave functions is consistent with experience and is free from the paradoxical features of the orthodox measurement theory. (auth)

36398 LINKED CLUSTER EXPANSION IN THE N BOSONS PROBLEM; PETIT CANONICAL ENSEMBLE. J. L. De Coen, F. Englert, and R. Brout (Université, Libre, Brussels). Physica, 30: 1293-1319(July 1964).

Perturbation methods based on linked cluster expansions are discussed for the many-boson system. A theory is presented that is valid at all temperatures. The derivation makes use of an algebraic theorem on creation and destruction operators. The canonical ensemble is used, thereby avoiding the introduction of the unknown chemical potential in the perturbation expansion. (C.E.S.)

36399 CALCULATION OF REGGE TRAJECTORIES IN POTENTIAL THEORY BY W.K.B. AND VARIATIONAL TECHNIQUES. J. I. Boukema (Univ. of St. Andrews, Scotland, U. K.). Physica, 30: 1320-5(July 1964).

It is shown how the W.K.B. method and the variational principle can be adapted to find Regge trajectories in potential theory. The methods are illustrated by calculations of non-relativistic Regge trajectories for a generalized Yukawa-type potential. (auth)

36400 KINETIC EQUATIONS AND STATIONARY STATE FOR A SYSTEM IN A UNIFORM EXTERNAL FIELD. G. Severne (Université, Brussels). Physica, 30: 1365-88(July 1964).

In an extension of the formalism developed by I. Prigogine and his collaborators, the generalized equations of evolution are derived for a system in the presence of an external field, of arbitrary strength and time dependence, but uniform in space. The basic new feature of both the non-Markoffian and the asymptotic equations consists in the field dependence of the collision term. The explicit form of these field corrections is worked out for a simplified description of a plasma in a constant electric field, and the limit of validity of the usual kinetic equations is specified. The generalized equation of evolution introduces a corrective term linear in the electric field which, for the stationary state, is precisely such as to ensure the complete equivalence with the linear response function formulation of the stationary state, i.e., with the Kubo formula. (auth)

36401 ON THE EQUATION OF MOTION AND FORM FACTORS OF CHARGED PARTICLES IN CLASSICAL ELECTRODYNAMICS. W. Cloetens (Université Libre, Brussels). Physica, 30: 1453-8(July 1964).

The special case of the non-relativistic approximation of the covariant equations of motion for extended particles in arbitrary motion is considered. This case corresponds to a linearization of the Prigogine–Henin electrodynamics and leads to expressions very similar to the Sommerfeld-Bohm-Weinstein equations for an extended charge. It can be verified that the theory is strictly causal and that what previously was the unphysical solution of the Lorentz-Dirac equation becomes a transient microscopic solution damped by radiation-damping after a time of the order of $\approx 10^{-23}$ sec. (C.E.S.)

36402 SOLID HELIUM AND THE UNCERTAINTY PRINCIPLE. William J. Mullin. Res. Rev. (Office Aerospace Res.), 3: No. 4, 6-8(June 1964).

The Heisenberg uncertainty principle is considered for the phenomenon of zero-point energy. Zero-point energy in solid helium-3 is discussed by means of particles trapped in a square potential well and by means of the Lennard-Jones potential. (C.E.S.)

36403 QUANTUM TRANSITIONS TO A CONTINUOUS SPECTRUM INDUCED BY AN ADIABATIC PERTURBATION. [PART] II. A. V. Chaplik (Inst. of Radiophysics and Electronics, Academy of Sciences, Siberian SSR). Zh. Eksperim. i Teor. Fiz., 47: 126-33(July 1964). (In Russian)

Adiabatic perturbation of the states of a particle in a spherically symmetric field is investigated for arbitrary values of the angular momentum. The dependence of the transition probability to a continuous spectrum on the energy and adiabaticity parameter is determined. The model of a system with an infinite number of discrete levels which condense towards the continuum boundary is considered. (auth)

36404 EQUATIONS OF MOTION FOR RADIATIVE OPERATORS. B. V. Medvedev (Inst. of Mathematics, Academy of Sciences, USSR). Zh. Eksperim. i Teor. Fiz., 47: 147-59(July 1964). (In Russian)

Equations of motion are set up for the current-like operators A_{in}, previously introduced, which together fix the scattering matrix. The equations (in vibrational derivatives) play the role of usual hamiltonian equations of motion in the Heisenberg representation in the axiomatic construction of the scattering matrix. (auth)

36405 EXTREMAL PROPERTIES OF APPROXIMATE METHODS OF COLLISION THEORY IN THE PRESENCE OF INELASTIC PROCESSES. M. Gailitis (Inst. of Physics, Academy of Sciences, Lavian SSR). Zh. Eksperim. i Teor. Fiz., 47: 160-6(July 1964). (In Russian)

A monotonous dependence of the scattering matrix on the potential energy operator is established. It is shown that many numerical methods yield an approximation from below for the reactance matrix. (auth)

36406 RELATION BETWEEN SINGLE INTEGRALS OF THE MANDELSTAM REPRESENTATION AND DOUBLE SPECTRAL FUNCTIONS. E. I. Malkov (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Eksperim. i Teor. Fiz., 47: 188-99(July 1964). (In Russian)

It is shown that it is impossible, without violating the unitarity condition ($|a_l| \leq 1$) in three channels, to add to the two-particle amplitude satisfying the unitarity condition any functions which possess in the finite part of complex space singularities with respect to only one variable (s, t, or u) and which at infinity grow slower than an exponential function, the only exceptions being terms corresponding to S and P waves in the three channels. This signifies that those parts of the amplitude which possess in the finite part of space only single variable singularities are determined by that part which contains singularities with respect to two variables. As an example, an expression is derived for the single integrals and subtraction polynominal of the Mandelstam representation in terms of double spectral functions. (auth)

36407 EQUATIONS FOR REGULARIZED GREEN FUNCTIONS. D. A. Slavnov (Moscow State Univ.). Zh. Eksperim. i Teor. Fiz., 47: 224-31(July 1964). (In Russian)

A variational equation is obtained for a certain quantity, a knowledge of which facilitates the calculation of any many-particle Green function. The equation is derived for a self-acting field by summation of perturbation series. If some auxiliary conditions are imposed on the coefficients in the equation, one obtains regularized values for the Green functions. Although the equations are derived on basis of perturbation theory, neither the equation itself nor any of the auxiliary conditions are formulated in such a way as to explicitly contain perturbation theory. (auth)

36408 ON THE COULOMB GREEN FUNCTION. V. G. Gorshkov (Ioffe Inst. of Physics and Tech., Leningrad).

Zh. Eksperim. i Teor. Fiz., 47: 352-9(July 1964). (In Russian)

A representation of the Green function for the Dirac equation is derived which is a generalization of the Furry-Sommerfeld-Maue approximation. A closed form for the nonrelativistic Green function in momentum space is found. (auth)

36409 A GENERALIZED ASYMPTOTIC CONDITION. Arthur Lewis Licht. Thesis, College Park, Md., Univ. of Maryland, 1963. 103p.

The LSZ asymptotic condition is extended so as to apply to a class of fields that describe "particles" of indefinite mass. Sufficient conditions are given for the convergence of the asymptotic limits. These conditions are shown to be valid for several simple model field theories, including the generalized free field and the Zachariasen-Thirring model. A proof is given that weakly local fields that satisfy the generalized asymptotic condition may be constructed in a wide class of relativistic field theories. The non-relativistic form of the generalized asymptotic condition is derived and is shown to be equivalent to the multi-particle asymptotic condition of Schweber and Sudarshan. (Dissertation Abstr., 24: No. 12, Pt. I (June 1964))

36410 POINT TRANSFORMATIONS IN THE MANY-BODY PROBLEM. Felix Martin Eger. Thesis, Waltham, Mass., Brandeis Univ., 1963. 187p.

The possibility of using the canonical extended point transformation in many-body problems is investigated. The transformation is first applied to the problem of two bodies interacting via a hard core potential; a fairly detailed analysis of this case is given. It is found that a unitary transformation of this type can be used to convert the hard core interaction into a velocity-dependent potential. The transformed Hamiltonian is quadratic in the momenta, with a space-dependent metric; and a new "metric" potential energy appears as a result of the non-commutativity of operators. The general form of the transformed two-body Hamiltonian is derived and special forms are used to compute the low-energy scattering cross section for a hard sphere interaction. The two-body transformation is applied to two specific many-body systems: the hard sphere boson gas, and a foreign body interacting with the boson gas. In the former case the transformed many-body Hamiltonian is assumed to be the sum over all pairs of the transformed two-body Hamiltonian. For low density, the low-lying energy spectrum thus obtained is in agreement with that of Lee and Yang. In the latter problem the point transformation is used to reduce the strong interaction between the foreign body and the bosons. Two existing treatments of the foreign body, that of Feynman and that of Gross, are combined and become limiting cases of the more general theory based on the point transformation. In this theory no additional approximation on higher order correlation functions are used. An attempt is also made to perform a full many-body transformation. Such a transformation is actually carried out for the case of the potential energy, where a decomposition in terms of permanents is made, and a method is devised for the exact and closed form calculation of the coefficients. It emerges that when the point transformation is used to eliminate the interaction to some order of accuracy, an approximate determination of all the spatial correlation functions is obtained. A full use of the many-body transformation requires also an evaluation of the metric. This problem has not yet been solved. (Dissertation Abstr., 24: No. 12, Pt. I (June 1964))

Geophysics

36411 A POSSIBLE CAUSE OF EXCITATIONS OF PP PULSATIONS. A. V. Sergeev (Inst. of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, Academy of Sciences, Siberian SSR). Geomagnetism Aeronomy (USSR) (English Transl.), 3: 790-1(1963).

The presence of an impact zone effect for solar charged particles in the diurnal distribution of short-period (PP) variations of the earth's electromagnetic field was investigated. (D.C.W.)

36412 ENERGY OF GEOMAGNETIC STORMS OF SEPTEMBER 1957. V. I. Afanas'eva (Inst. of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, Academy of Sciences, USSR). Geomagnetism Aeronomy (USSR) (English Transl.), 3: 766-70(1963).

A number of problems concerning the structure of solar corpuscular streams are examined by means of an energy characteristic of the form $E = a\delta H + b(\delta H)^2 + C\Delta H$, where δH is the variation at the equator and ΔH is the variation created in the auroral zone by currents in the ionosphere. (auth)

36413 FAMILIES OF GEOMAGNETIC STORMS DURING THE INTERNATIONAL GEOPHYSICAL COOPERATION. V. I. Afanas'eva (Inst. of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, Academy of Sciences, USSR). Geomagnetism Aeronomy (USSR) (English Transl.), 3: 760-5(1963).

Data on the geomagnetic storm families for 1959 are tabulated, and the role of sudden commencement in storm families is discussed. Examination of the seasonal variations of the number of sudden commencement storms shows that they occur most frequently in summer. (D.C.W.)

36414 ELECTRIC FIELD OF A POLAR MAGNETIC DISTURBANCE. B. E. Bryunelli (Leningrad State Univ.). Geomagnetism Aeronomy (USSR) (English Transl.), 3: 746-51(1963).

The electric field which develops in the ionosphere during a polar geomagnetic disturbance is investigated. During a negative disturbance produced by a current flowing along an arc, positive charges accumulate at the western edge of the arc, while negative charges accumulate at its eastern edge. The potential difference between the edges of the arc is ~10 to 20 kv. Two current systems form in the space beyond the arc—a resistive system with current flowing along the electric field and a Hall system with current flowing along isopotential lines. The latter system produces the observed discontinuity in the current system of the disturbance near the edge of the arc. The polarization field within the arc produces the drift of electrons at a velocity of ~50 m/sec toward the north and the formation of a current with a density of about 100 a/km across the zone. The polarization field induces particle motion across the magnetic field in the vicinity of the radiation belt and this promotes the replenishment of particles that are lost during injection and may create acceleration in the region of the neutral line. The latter is possible only with negative magnetic disturbances, and this explains the difference in the activity of both types of disturbances and the auroras accompanying them. (auth)

36415 ANOMALOUS ABSORPTION IN THE POLAR CAP RESULTING FROM LARGE CHROMOSPHERIC FLARES. G. M. Khocholava (Inst. of Geophysics, Academy of Sciences, Georgian SSR). Geomagnetism Aeronomy (USSR) (English Transl.), 3: 735-40(1963).

Anomalous absorption in the polar cap is studied. The most disturbed periods of anomalous absorption are investigated, and two types of anomalous absorption and their duration and diurnal variation are examined. (auth)

36416 APPEARANCE OF IONOSPHERIC INHOMOGENEITIES IN THE F-LAYER. B. N. Gershman (Gor'kii State Univ., USSR). Geomagnetism Aeronomy (USSR) (English Transl.), 3: 710-15(1963).

A mechanism associated with the instability of drift motions of charged particles in the F-layer is proposed for the formation of ionospheric inhomogeneities. (auth)

36417 DETERMINATION OF THE ELECTRON RECOMBINATION RATE IN THE F_2-LAYER FROM THE DIURNAL IONIZATION VARIATION. V. M. Polyakov (Irkutsk State Univ., USSR). Geomagnetism Aeronomy (USSR) (English Transl.), 3: 702-9(1963).

An attempt is made to determine the form of the ionization function and the values of the ionization-recombination parameters of the F_2-layer of the ionosphere at middle latitudes from the diurnal ionization variation over Irkutsk for the period from 1948 to 1960. It is shown that the rate of electron disappearance differs significantly at different times of the day in different seasons and is determined by the concentration of molecular ions in the atmosphere. It is noted that the characteristics of diurnal and seasonal variations in electron concentration in the F_2-layer maximum are largely determined by recombination processes. (auth)

36418 EXPERIMENTAL DATA ON THE MAGNITUDE OF ENERGY SOURCES IN THE IONOSPHERE. A. D. Danilov and G. S. Ivanov-Kholodnyy (Inst. of Applied Geophysics, [Academy of Sciences], USSR). Geomagnetism Aeronomy (USSR) (English Transl.), 3: 688-93(1963).

Investigations of solar uv radiation indicate that the energy of this radiation at the time of maximum solar activity ranges from 3 to 10 ergs/cm^{2}sec. The observed value of the effective recombination coefficient in the ionosphere gives the total number of recombinations in a column of the ionosphere corresponding to an energy of ~6 ergs/cm^{2}sec. A comparison of laboratory data on the coefficient of dissociative recombination of molecular ions with experimental data on the concentrations of these ions in the atmosphere indicates that there is a great number of recombinations per second in a column of the atmosphere, corresponding to 10 to 25 ergs/cm^{2}sec. Measurements of the constants of ion-exchange reactions confirm the concept that there are rapid recombination processes transpiring in the ionosphere. Evaluations of the energy necessary for maintaining the observed temperatures in the upper atmosphere give values of the order of 2 to 10 ergs/cm^{2}sec. The most reliable data on the magnitude of energy sources in the ionosphere now indicate a value of 3 to 10 ergs/cm^{2}sec. A number of problems concerning the energy source and the energy balance in the earth's upper atmosphere are discussed. (auth)

36419 IONIZING RADIATION AND WARMING OF THE UPPER ATMOSPHERE. V. I. Lazarev (Inst. of Applied Geophysics, [Academy of Sciences,] USSR). Geomagnetism Aeronomy (USSR) (English Transl.), 3: 681-7(1963).

The warming of the upper atmosphere by wave and corpuscular ionizing radiation is investigated. By examination of photochemical processes in the upper atmosphere the vertical temperature distribution is derived. It is shown that about 40% of the ionizing radiation energy absorbed in the atmosphere is converted into heat. The daytime flux of ionizing radiation is estimated at 3 to 12 erg/cm^{2}sec from data on the warming of the upper atmosphere. The vertical temperature distribution in the night ionosphere is computed. It is shown that the warming of the upper atmosphere at night may be caused by electrons of an energy exceeding 100 ev with a flux of ~0.4 to 1.6 erg/cm^{2}sec. It is found that at night the temperature at a height of 200 km is ~700°K and at 350 km, ~1130°K. (auth)

36420 RELATIONSHIP BETWEEN SOME IONSOPHERIC CHARACTERISTICS AND GEOMAGNETIC ACTIVITY. V. D. Kokourov (Inst. of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, Academy of Sciences, Siberian SSR). Geomagnetism Aeronomy (USSR) (English Transl.), 3: 800-2(1963).

The relation between the average amplitude of a reflected signal, the turbidity of the ionosphere and ionospheric absorption, and the degree of magnetic-ionospheric disturbance was investigated in an analysis of data obtained at Yakutsk on ionospheric absorption at 2.2 Mcps. (D.C.W.)

36421 COMBINED EFFECTS OF DRIFT AND DIFFUSION IN THE F2 REGION. P. C. Kendall and D. W. Windle (Univ. of Sheffield, Eng.). Nature, 203: 287-8(July 18, 1964).

The problem of a self-maintained equilibrium layer in the absence of electron production and loss is examined by means of the F2 region equilibrium diffusion-drift equation. (C.E.S.)

36422 GENERATION OF WHISTLER WAVES BY HELICAL ELECTRON BEAMS. Jacob Neufeld and Harvel Wright (Oak Ridge National Lab., Tenn.). Nature, 203: 288-9(July 18, 1964). (ORNL-P-25)

The generation of whistler waves in the interaction of a stationary plasma in the ionosphere with an assembly of geomagnetically trapped electrons is discussed. The trapped particles spiral around the lines of the geomagnetic field B_0. It is shown that if the electrons in the beam have trajectories aligned along the direction parallel to that of B_0, there is only one type of instability (P-instability). If the beam is helical there is an additional instability (B-instability) which gives rise to excited B-waves. The properties of the whistler B-waves are discussed. (C.E.S.)

36423 ON THE INFLUENCE OF COMPOSITION AND SPECTRA OF SOLAR COSMIC RAYS ON THE INTENSITY RATIO I(λ5577)/I(λ3914) IN POLAR-GLOW AURORA. R. R. Brown (Kiruna Geophysical Observatory, Sweden). Planetary Space Sci., 12: 665-74(July 1964).

Using exponential rigidity spectra for solar cosmic ray protons and alpha particles, it is shown that the presence of alpha particles increases the intensity ratio I(λ5577)/I(λ3914) in polar-glow aurora and that, for a constant composition, steepening of rigidity spectra has the same effect. Representative values for I(λ5577)/I(λ3914) show that variations in composition and spectral shape in the course of solar cosmic ray events, individually, produce changes of comparable magnitude in the intensity ratio. (auth)

36424 RADIO AURORA. Bengt Hultqvist and Alv Egeland (Kiruna Geophysical Observatory, Sweden). Space Sci. Rev., 3: 27-78(July 1964).

Reflections of radio waves from ionization associated with aurora (radio aurora) are discussed. Methods of measurement, time characteristics of auroral reflections, spatial characteristics of radio aurora, auroral-echo strength, apparent motion of radio aurora, amplitude distribution and fading of auroral reflections, frequency dependence of radio aurora, polarization characteristics of radio aurora, correlations of radio aurora with other upper

atmosphere parameters, and theories for the auroral reflection process are considered. (C.E.S.)

Low Temperature Physics

36425 (SRB-63-5) SUPERCONDUCTIVITY, JANUARY–JUNE 1963. AN ANNOTATED BIBLIOGRAPHY. Jack B. Goldmann, comp. (Lockheed Missiles & Space Co., Sunnyvale, Calif.). July 1963. 118p. (AD-438180)

Current theory, properties, and applications of superconductors as presented in the literature from January to June 1963, are covered in the annotated bibliography. The 242 entries, representing English and foreign language publications are listed alphabetically by author. To facilitate location of specific terms, author and subject indexes are included. (auth)

36426 ALTERNATING CURRENT POWER LOSSES IN SUPERCONDUCTING Nb–Zr ALLOYS. W. R. Wisseman, L. A. Boatner, and F. J. Low (Texas Instruments Inc., Dallas). J. Appl. Phys., 35: 2649-55(Sept. 1964).

A calorimetric technique, involving measurement of the thermal conductivity, was used to measure non-ohmic a-c power losses in short, 0.25-mm-diameter samples of superconducting Nb–25% Zr and Nb–33% Zr wire as a function of frequency, current amplitude and waveform, and temperature. The observed power losses at 4.2°K ranged from 6×10^{-11} to 10^{-7} w/cm. The losses depended linearly on frequency in the range 60 to 40,000 cps and decreased approximately as $T^{2.5}$ for temperatures T in the range 2.0 to 4.2°K. Peak currents from 1 to 8 amp were used to determine that the power loss was a function of the peak current I_m, rather than the rms current, and also was proportional to I_m^n, where n varied from 2.6 to 4.5. These results indicate a hysteresis loss mechanism with no detectable relaxation effects for the entire frequency range covered. Models which have been proposed to account for hysteresis losses in hard superconductors are discussed. The results of the experiment are compared with earlier measurements on Nb–Zr alloys. There is considerable disagreement between the present results and the published results of Zar in magnitude and in the frequency and current dependences of the a-c power losses. (auth)

36427 ON THE FLOWING HELIUM FILM. S. Franchetti (Università, Florence). Nuovo Cimento (10), 33: 144-7(July 1, 1964).

The effect of flow on helium II films is considered both in reversible and irreversible conditions, and the results of some experiments are discussed. (auth)

36428 INEQUIVALENT REPRESENTATIONS AND SUPERCONDUCTIVITY. L. Leplae and H. Umezawa (Università, Naples). Nuovo Cimento (10), 33: 372-96(July 16, 1964).

Superconductivity is considered in the theory of the inequivalent representations for the quantized field. This theory naturally leads to the conclusion that the ground state is not an eigenstate of the number of electrons. This conclusion is independent of the assumption of the pair effects, although the final results are the same as those of the BCS theory. It is shown that the quantization of the magnetic flux can also be explained by this viewpoint. The method of the computation for higher-order effects is briefly discussed. (auth)

36429 INFLUENCE OF PRESSURE UP TO 30 000 KG/CM² ON THE SUPERCONDUCTING TRANSITION TEMPERATURE OF Nb_3Sn. W. Buckel, W. Gey, and J. Wittig (Technische Hochschule, Karlsruhe). Phys. Letters, 11: 98-9(July 15, 1964).

The influence of pressure up to 30,000 kG/cm² on the superconducting transition temperature of Nb_3Sn was investigated to clear up previous discrepancies. The superconducting transition was observed by resistance measurements. It is concluded that the critical temperature of Nb_3Sn seems to be much more sensitive to hydrostatic pressure than the transition temperature of any superconductors. (C.E.S.)

36430 SURFACE SUPERCONDUCTIVITY AND SUPERCOOLING IN Hg–Cd ALLOYS. M. Cardona and B. Rosenblum (RCA Labs., Princeton, N. J.). Phys. Letters, 11: 112-13(July 15, 1964).

The microwave surface resistance of pure Hg and a series of Hg–Cd alloys was measured between 1.6°K and the transition temperature (4.1°K). Supercooling, but no surface superconductivity, was observed throughout this temperature range for pure Hg and for the alloys with 0.5 and 0.9 at. % Cd. Because of the increase of the Ginzburg-Landau parameter κ with decreasing temperature the alloys with 1.5 and 2 at. % Cd show only surface superconductivity below a critical temperature and only supercooling above it. The two phenomena are mutually exclusive. (C.E.S.)

36431 LAMBDA TRANSFORMATION OF LIQUID HELIUM FOUR. Louis Goldstein (Los Angeles Scientific Lab., N. Mex.). Phys. Rev., 135: A1471-80(Sept. 14, 1964). (LADC-6367)

It will be shown that the extrapolation of empirical logarithmic expressions of a group of thermal properties of liquid ^{4}He at the approaches of the lambda transformation, implying their singular behavior, is without physical justification. These properties do not even start to become large until one invokes temperature separations from the lambda temperatures, the argument of the logarithmic expressions, which are very many orders of magnitude smaller than the root-mean-square temperature fluctuations of the liquid-^{4}He samples investigated. Consideration of temperature intervals smaller than the root-mean-square temperature fluctuations is excluded by statistical thermodynamics. On analyzing the lambda transformation at melting, an exact thermodynamic relation is proved through the geometrical properties of a class of isochores in the pressure-temperature diagram. Provided that the thermodynamic characteristics of the lambda transformation remain invariant all along the transformation locus, the thermodynamic relation proved at melting has the following corollaries: If the transformation volume line is not parabolic in temperature at the approaches of its end point at melting, singularities of a group of interrelated thermal properties must exist at the lambda transition. If this approach is parabolic, the existence of singularities neither is necessary nor can it be ruled out. In the latter case, new physical approaches would be needed for an unambiguous determination of the existence or absence of singularities of thermal properties at the lambda transformation. (auth)

36432 CRITICAL FIELD AND SPECIFIC HEAT OF STRONG COUPLING SUPERCONDUCTORS. Yasushi Wada (Univ. of Pennsylvania, Philadelphia). Phys. Rev., 135: A1481-97(Sept. 14, 1964).

Expressions for thermal quantities such as the critical field, entropy, and specific heat are derived for strong coupling superconductors without making a quasiparticle approximation for electron motions. The contributions from the ion motions are also taken into account semiphe-

nomenologically. Nambu's Green's-function formalism at finite temperature is used as well as a relation, derived by Chester, between the differences of the thermal averages of the total hamiltonian and the ion kinetic energy between the normal and the superconducting phases. Assuming the simple isotope effect, where the transition temperature is proportional to the inverse square root of the ionic mass, the phase transition is shown to be of the second order. The thermal quantities are given in terms of a single function of the temperature and its derivatives, which can be obtained from the energy-gap function and the renormalization factor of the electron Green's function. These expressions lead to the BCS results in the appropriate limit. A new expression for the jump in specific heat is also derived. For strong coupling superconductors it is likely to give better agreement with experiments than the BCS expression. Present theory does not apply to superconductors with isotope effect not simple as above. A possible reason is discussed. (auth)

36433 THEORY OF CRYSTALLINE He^3 AT 0°K. L. H. Nosanow (Univ. of Minnesota, Minneapolis). Phys. Rev. Letters, 13: 270-2(Aug. 24, 1964).

The effects of pair correlations in crystalline ^3He were studied by means of a variational calculation with Jastrow-type wave functions. A systematic cluster expansion of the ground-state energy is derived and is shown to converge rapidly for crystalline ^3He. (R.E.U.)

36434 CRITICAL CURRENTS IN SUPERCONDUCTING WIRES AND RIBBONS COVERED WITH Nb_3Sn. F. F. Dettmann and F. K. Lange (Lab. of Low-Temperature Physics, Dresden). Zh. Eksperim. i Teor. Fiz., 47: 61-3 (July 1964). (In Russian)

The critical currents of Nb_3Sn-coated niobium wires and ribbons are measured at temperatures above 14°K and in magnetic fields below 30 kOe. The critical current of the ribbons depends on orientation of the latter with respect to the magnetic field. (auth)

36435 SURFACE TENSION OF LIQUID HYDROGEN ISOTOPES AND HYDROGEN–DEUTERIUM SOLUTIONS. V. N. Grigorev and N. S. Rudenko. Zh. Eksperim. i Teor. Fiz., 47: 92-6(July 1964). (In Russian)

Experimental data are presented on the temperature dependence of the surface tension of hydrogen, deuterium, deuterohydrogen and also for hydrogen–deuterium solutions. The data on the surface tension of hydrogen satisfactorily agree with the results obtained by Kamerlingh-Onnes whereas the results previously obtained by Van Itterbeek and Van Paemel for deuterium are too high by ~5%. The surface tension of the solutions is several percent smaller than the additive values, which is in quantitative agreement with Prigogine's calculations. (auth)

36436 LOWER CRITICAL FIELD AND NONLINEAR EFFECTS IN THE ELECTRODYNAMICS OF SUPERCONDUCTING ALLOYS. T. K. Melik-Barkhudarov (Inst. of Physics, Erevan). Zh. Eksperim. i Teor. Fiz., 47: 311-24(July 1964). (In Russian)

The lower critical field H_{c1} for the highly impure alloys ($l \ll \xi_0$) is found. It is given by formulas in terms of the thermodynamic critical field. Corrections to the penetration depth of a weak magnetic field into a superconducting alloy are also computed. (auth)

36437 CRYOGENICS. Michael McClintock. New York, Reinhold Publishing Corporation, 1964. 279p. $10.75.

The production and maintenance of low-temperatures; phenomena that occur at low-temperatures including liquid helium behavior, low-temperature mechanical, magnetic, thermal, and transport properties of solids, and the superconductivity of metals and alloys; and applications of cryogenics are discussed. (R.E.U.)

36438 APPLIED SUPERCONDUCTIVITY. Vernon L. Newhouse. Wiley Series on the Science and Technology of Materials. New York, John Wiley and Sons, 1964. 295p. $8.50.

Bulk superconductivity, theories of superconductivity, and superconducting films are discussed. A survey of superconductive devices is presented: included are electromagnets and flux pumps, amplifiers and electronic switching elements, digital storage cells and resonant cavities, and heat valves and infrared detectors. (R.E.U.)

36439 PROCEEDINGS OF THE EIGHTH INTERNATIONAL CONFERENCE ON LOW TEMPERATURE PHYSICS, HELD AT QUEEN MARY COLLEGE, LONDON, 16-22 SEPTEMBER 1962. R. O. Davies, ed. Washington, D. C., Butterworths, 1963. 464p. $39.00.

Separate abstracts were prepared for 111 of the 173 papers on the general topics of ^3He, ^4He, macroscopic quantization in superconductors, superconductivity in relation to transition elements, energy gaps in superconductors—tunneling and ultrasonic absorption, applications of low temperature phenomena, and paramagnetic cooling. The papers not abstracted separately are on the general subjects of the magneto-acoustic effect, spin ordering, spin-phonon interactions, and lattice dynamics. Fourteen of the papers were abstracted in NSA previously as 16: 13817, 25997, 30969, 32121; 17: 3616, 5145, 6852, 18896, 18907, 24056, 28036, 30526, 31171; 18: 6126. (M.P.G.)

For abstracts of individual papers see: 36440, 36441, 36442, 36443, 36444, 36445, 36446, 36447, 36448, 36449, 36450, 36451, 36452, 36453, 36454, 36455, 36456, 36457, 36458, 36459, 36460, 36461, 36462, 36463, 36464, 36465, 36466, 36467, 36468, 36469, 36470, 36471, 36472, 36473, 36474, 36475, 36476, 36477, 36478, 36479, 36480, 36481, 36482, 36483, 36484, 36485, 36486, 36487, 36488, 36489, 36490, 36491, 36492, 36493, 36494, 36495, 36496, 36497, 36498, 36499, 36500, 36501, 36502, 36503, 36504, 36505, 36506, 36507, 36508, 36509, 36510, 36511, 36512, 36513, 36514, 36515, 36516, 36517, 36518, 36519, 36520, 36521, 36522, 36523, 36524, 36525, 36526, 36527, 36528, 36529, 36530, 36531, 36532, 36533, 36534, 36535, 36536, 36537, 36538, 36539, 36540, 36541, 36542, 36543, 36544, 36545, 36546, 36547, 36548, 36549, and 36550.

36440 DEVELOPMENT OF CONCEPTS IN SUPERCONDUCTIVITY. John Bardeen (Univ. of Illinois, Urbana). p.3-8 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

The major theoretical and experimental advances leading to the development of the microscopic theory of superconductivity are outlined. Some current problems include derivation of the effective interaction giving rise to superconductivity, the isotope effect in nontransition metal superconductors, and anisotropic effects in superconductors. The theory of superconductivity has been successfully applied to problems in the fields of nuclear structure and elementary particles. (M.P.G.)

36441 HELIUM THREE. Andrew M. Sessler (Univ. of California, Berkeley). p.11-16 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

Helium-3 plays a fundamental role in the physics of many-body systems. Theoretical understanding of the problem is limited to the temperature region below 0.1°K. In the discussion of ^{3}He as a Fermi liquid, Landau's phenomenological theory is reviewed and compared with experiment. The propagation of zero sound in liquid He and several microscopic theories are discussed. The general features of solid ^{3}He, such as spin ordering and crystallographic phases, are briefly commented upon. The theoretical possibilities of a superfluid phase of liquid ^{3}He are reviewed. Theoretical estimates of the transition temperature, T_c, below which perturbation theory is invalid range from 2×10^{-4}°K to 8×10^{-3}°K. At present, T_c can not be quantitatively evaluated, but it is hoped that it will lie within an experimentally attainable range. (M.P.G.)

36442 FERMI-DIRAC SPIN DEGENERACY IN ^{3}He VAPOR. R. H. Romer (Amherst Coll., Mass.). p.17-18 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

Measurements of the spin susceptibility of liquid ^{3}He show that liquid ^{3}He does not behave like an ideal Fermi-Dirac gas. The spin susceptibility of ^{3}He vapor at temperatures ~3.0°K was observed as a function of density at a fixed temperature. Data of relative measurements of susceptibility are presented and compared with ideal Fermi-gas calculations. The behaviour of ^{3}He vapor is shown to be much closer to ideal Fermi-gas behaviour than that of liquid ^{3}He, although deviations from the ideal Fermi-gas formula were observed at higher densities. (M.P.G.)

36443 NUCLEAR SUSCEPTIBILITY OF LIQUID ^{3}He UNDER PRESSURE. A. L. Thomson and H. Meyer (Duke Univ., Durham, N. C.). p.19-21 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

The nuclear susceptibility of liquid ^{3}He was determined at pressures up to 30.7 atm and at temperatures down to 0.045°K. The height of the nuclear resonance absorption was measured by sweeping through resonance. Resonance occurred in a field of ~1000 G with the tank circuit tuned to 3.3 Mc. The experiments are described, and data are presented in graphs of susceptibility vs temperature^{-1} and susceptibility vs pressure. Below 0.1°K, the data could be fitted to curves calculated for an ideal Fermi-Dirac gas with an appropriate effective Fermi temperature. A strain gage of magnanin wire, whose resistance varies with pressure, was developed to measure directly the pressure of ^{3}He. (M.P.G.)

36444 LOW TEMPERATURE SUSCEPTIBILITY OF ^{3}He. J. M. Goodkind, E. Dwight Adams, D. H. Cohen, and W. M. Fairbank (Stanford Univ., Calif.). p.22-3 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

An apparatus is described, which was designed to study the properties of ^{3}He at pressures up to 2000 psi and temperatures down to 0.003°K. A ^{3}He refrigerator was used followed by demagnetization of a Cr-K alum salt pill and then of a Ce-Mg nitrate pill. Superconducting persistent-current magnet were used, and temperatures were measured with 2 nuclear-magnetic-resonance thermometers. Temperatures lower than 0.014°K have not yet been obtained. Measurements in a field of 1000 G at vapor pressures of 250 and 400 psi indicate that the susceptibility of liquid ^{3}He is temperature independent within ±5% down to 0.014°K. (M.P.G.)

36445 NUCLEAR MAGNETIC SUSCEPTIBILITY OF LIQUID ^{3}He. B. T. Beal, D. F. Brewer, J. Hatton, and M. G. Richards (Oxford Univ.). p.24 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

The nuclear magnetic resonance absorption of liquid ^{3}He was measured at 4.2 Mc/sec at pressures up to 35 atm and temperatures from 1 to 3°K. A tuned circuit containing the ^{3}He sample was fed from a separate constant-current r-f oscillator, and the signals, after amplification and detection, were photographed from an oscilloscope. The area of the resonance signal is a measure of the nuclear magnetic susceptibility. Data are presented in graphs of susceptibility as a function of pressure and temperature, and it is concluded that the molar susceptibility, although independent of pressure, does not have the classical Curie value except possibly at higher temperatures. Directly measured values of the spin-lattice relaxation time are also given. (M.P.G.)

36446 THE COMPETITION BETWEEN THE EXCLUSION PRINCIPLE AND EXCHANGE IN LIQUID ^{3}He. H. E. Rorschach, Jr., and H. A. Schwettman (Rice Univ., Houston, Tex.). p.25-6 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

The temperature and density dependence of the susceptibility of ^{3}He was studied at temperatures from 0.92 to 2.9°K. The susceptibility of pure ^{3}He and mixtures of ^{3}He and ^{4}He was measured within ±1% by the technique of adiabatic fast passage. Data on the deviation of the susceptibility from the Curie value are presented in graphs. Above 1.2°K the deviation is small; it is ~2% at 1.2°K and increases below that temperature. The temperature dependence was the same for pure ^{3}He and for mixtures of ^{3}He and ^{4}He. (M.P.G.)

36447 THE PRESSURE DEPENDENCE OF THE ENTROPY OF LIQUID ^{3}He DOWN TO 0.04°K. D. F. Brewer and J. R. G. Keyston (Oxford Univ.). p.27-8 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

The entropy as a function of temperature at various pressures was calculated by integrating constant-pressure specific heat data down from 0.12°K. A reference entropy, S = 2.41 J/mole-degree at 15-cm pressure, and the entropy of compression were obtained from previous measurements. The isobaric expansion coefficient, α_p, is shown to be negative. Evaluation of $d\alpha_p/dT$ from the specific heat work gives ~-0.1 degree^{-2} near the vapor pressure at very low temperatures, and $-d\alpha_p/dT$ ~0.05 degree^{-2} at a pressure of 25 atm. (M.P.G.)

36448 SOUND PROPAGATION IN ^{4}He AND ^{3}He-^{4}He MIXTURES. James H. Vignos and Henry A. Fairbank (Yale Univ., New Haven). p.31-3 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

The longitudinal velocity of sound was measured in liquid and solid ^{4}He and ^{3}He-^{4}He mixtures using the time-of-flight pulse technique at a carrier frequency of 10 Mc/sec. Data are presented graphically for ^{4}He and ^{3}He-^{4}He mixtures containing 5.0, 74.9, and 98.0% ^{3}He. Phase diagrams for the samples are also presented and discussed. The attenuation of sound at 10 Mc/sec in solid ^{4}He and a ^{3}He-^{4}He mixture containing 98.0% ^{3}He was measured over a wide range of temperature and pressure and found to be of the order of 0.3 to 0.7 cm^{-1}. (M.P.G.)

36449 THE HEAT CONDUCTIVITY OF GASEOUS ^{3}He AND ^{4}He BETWEEN 0.4° AND 3.0°K. K. Fokkens, F. W. Taconis, and R. de Bruyn Ouboter (Kamerlingh Onnes Laboratorium, Leiden). p.34-6 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

The heat conductivity of gaseous ^{3}He and ^{4}He was de-

termined using a ^{3}He cryostat. The gas was put between 2 parallel Cu plates, one plate being kept at constant temperature and the other heated. The heat conductivity of the gas could be calculated from measurements of the temperature difference between the plates as a function of heat input and distance. The apparatus is described, and results are presented graphically. Heat conductivity coefficients for ^{3}He were found to be 4.82×10^{-5}, 5.14×10^{-5}, 5.17×10^{-5}, and 6.84×10^{-5} W/cm degree for temperatures of 0.75, 0.77, 0.896, and 1.086°K, respectively. For ^{4}He, heat conductivity coefficients were found to be 3.34×10^{-5}, 3.38×10^{-5}, and 3.47×10^{-5} W/cm degree for temperatures of 1.100, 1.304, and 1.547°K, respectively. The results agree well with theoretical calculations of Buckingham (Proc. Phys. Soc. (London), A65: 376(1952)). (M.P.G.)

36450 MEASUREMENTS OF THE MELTING CURVES OF ^{3}He–^{4}He MIXTURES. H. Weinstock, F. P. Lipschultz, C. F. Kellers, and D. M. Lee (Cornell Univ., Ithaca, N. Y.). p.41-2 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

The melting curves of a 25 mole % ^{3}He–75 mole % ^{4}He mixture and pure ^{4}He were measured between 0.4 and 1.1°K using a strain gage technique. The melting curve minimum of the mixture was found to occur at the surprisingly high temperature of 0.85°K, the melting pressure minimum being 22.7 atm. For pure ^{4}He, the melting pressure remained constant at 25.05 atm within ±0.1 atm down to 0.45°K. (M.P.G.)

36451 ON A POSSIBLE STATE OF SUPERMOBILITY IN ^{3}He–^{4}He MIXTURES. J. M. J. Van Leeuwen and E. G. D. Cohen (Universiteit, Amsterdam). p.43-4 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

The properties of an isotopic mixture of a hard sphere Fermi and Bose gas were studied as a model of ^{3}He–^{4}He mixtures using a pseudo-potential method. The model shows a phase separation in reasonable agreement with that occurring in ^{3}He–^{4}He mixtures, although the properties of the model must be calculated at lower densities than the density of the He mixture. The ground state of the model, treated to second order in a, the hard sphere diameter, is shown to be the same type as that occurring in the theory of superconductivity. A criterion is formulated for the existence of a state of "supermobility" of the Fermi particles in the mixture. The physical characteristics of supermobility are discussed. It would be possible to observe supermobility effects only in low concentration mixtures. (M.P.G.)

36452 INFLUENCE OF A SMALL AMOUNT OF ^{3}He ($10^{-5} < \chi < 3 \times 10^{-3}$) ON THE PROPAGATION OF HEAT PULSES THROUGH He II BELOW 1°K. C. G. Niels-Hakkenberg, L. Meermans, and H. C. Kramers (Kamerlingh Onnes Laboratorium, Leiden). p.45-6 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

Experimental and theoretical values on the propagation of heat pulses in the second sound region in very dilute solutions of ^{3}He in He II are compared. Second sound absorption is reduced by the presence of ^{3}He excitations, since the mean free path of the thermal excitations is shortened. The diffusive phonon signal is discussed, and values of the mean free path, l_s, are deduced and presented graphically. (M.P.G.)

36453 THE VELOCITY OF SOUND IN LIQUID ^{3}He. B. E. Keen, P. W. Matthews, and J. Wilks (Oxford Univ.). p.47-8 of "Low Temperature Physics." Washington, D. C. Butterworths, 1963.

Experiments are described in which the velocity and attenuation of sound are to be measured down to very low temperatures to observe zero sound, which is propagated by collective interactions between atoms rather than collisions between individual atoms. Using a quartz crystal and a microwave cavity, the velocity of 1000 Mc/sec sound was measured in liquid ^{4}He and ^{3}He down to 1°K. The measurements are being extended to lower temperatures, since zero sound is expected to occur below 0.05°K at 1000 Mc/sec. (M.P.G.)

36454 IONIC MOBILITY IN LIQUID ^{3}He. I. Modena (CNEN, Frascati, Italy). p.51-2 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

The mobility of positive ions in liquid ^{3}He was measured using a time-of-flight method. Measurements were made at temperatures between 1.1 and 2.6°K and pressures between the saturated vapor pressure and 1 atm. The mobility was found to depend slightly on temperature and to be independent of applied electric field between 180 and 430 v/cm. Reasonable agreement was obtained with other data. (M.P.G.)

36455 IONS AS PROBES INTO QUANTUM FLUIDS. Lothar Meyer, S. A. Rice, and H. T. Davis (Univ. of Chicago). p.53-5 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

The mobilities of the positive and negative charge carriers produced by α particles from a Po-210 source in liquid ^{3}He were measured at temperatures from 1 to 3°K and pressures from 1 to 3 atm. Similar measurements were made in liquid ^{4}He I, liquid Ar, Kr, and Xe. The drift velocity as a function of the applied field was determined from direct time-of-flight measurements. A graph of the mobility as a function of density in liquid ^{3}He and ^{4}He I indicates that the mobility is primarily a function of the density. The mobility of the ions shows the same small temperature dependence as uncharged particles. A quantitative description of charge transport phenomena in ^{3}He is presented, assuming that the positive charge carrier is He_2^+ and the negative is a free electron. (M.P.G.)

36456 MAGNETIC RESONANCE MEASUREMENTS ON β-PHASE ^{3}He BELOW 1°K. Richard L. Garwin and André M. Landesman (Columbia Univ., New York). p.56-8 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

Spin echo measurements were made of relaxation times, T_1 and T_2, and susceptibility on β-phase ^{3}He at temperatures down to 0.38°K, at freezing pressures up to 340 atm, and in magnetic fields between 120 and 800 G. The exchange interaction J was computed from the temperature-independent limit of the transverse relaxation time T_2. A three-reservoir model for the spin system and the lattice is discussed. Two mechanism for exchange-lattice relaxation, diffusion and thermal vibrations working through a two-phonon process, are proposed. Below 1°K the susceptibility did not obey Curie's Law, but at constant temperature the susceptibility gradually increased to the Curie value. This effect was identified with the exchange-lattice relaxation time, and the time constant was found to increase with decreasing temperature. (M.P.G.)

36457 NUCLEAR MAGNETIC RESONANCE EXPERIMENTS ON ADSORBED ^{3}He. M. Santini (Universitá,

Rome). p.59 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

Preliminary measurements of the spin-lattice relaxation time in adsorbed He-3 from 0.9 to 2.6°K are reported. Results indicate the appearance of a phase transition, either from a liquid to solid phase or between the α- and β-phase of 2 solid phases. (M.P.G.)

36458 MEASUREMENTS OF T_1 IN LIQUID ^{3}He NEAR THE MELTING CURVE MINIMUM. H. Weinstock, F. P. Lipschultz, C. F. Kellers, and D. M. Lee (Cornell Univ., Ithaca, N. Y.). p.60-1 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

The longitudinal relaxation time T_1 of liquid ^{3}He was measured at temperatures from 0.15 to 1.0°K and at a frequency of 3.1 Mc/sec. A blocked-capillary method was used for the nuclear-magnetic-resonance saturation measurements. For pressures up to 29.95 atm, values of T_1 were of the order of 60 to 90 sec for the liquid near the negative slope of the melting curve. At pressures above 30.0 atm, it was not possible to keep the sample entirely liquid. It is concluded that some previous results for liquid ^{3}He are based on solid-liquid samples. (M.P.G.)

36459 MACROSCOPIC QUANTIZATION IN HELIUM. H. E. Hall (Univ. of Manchester, Eng.). p.69-72 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

Weaknesses in the theory of quantized circulation in He II are discussed. Feynman's argument is too general. Byers' and Yang's theory of quantized flux in superconductors is applied to an uncharged Fermi system and compared with Feynman's argument. A close connection between macroscopic quantization and frictionless flow is demonstrated. Vinen's experiment on circulation around a vibrating wire gives direct evidence for macroscopic quantization. Additional experiments with uniformly rotating He are discussed in connection with the properties of vortex lines, turbulence, and critical velocities. (M.P.G.)

36460 CRITICAL VELOCITIES IN CAPILLARY TUBES AND QUANTIZED VORTEXES. V. P. Peshkov and V. K. Tkachenko (Inst. for Physical Problems, Moscow). p.73-4 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

Vortex motion along a capillary tube was studied using a He-filled capillary through which the heat flow was passed. Thermometers along the tube determined the location of vortexes. The front propagation velocity was found to be inversely proportional to the diameter of the capillary tube, indicating the quantum character of circular vortexes. In a 1.4-mm tube, vortexes were generated in the middle of the tube in addition to the ends. Experimental results prove that the natural critical velocities and the kinetics of the disturbance of superfluid motion in capillary tubes are related to the appearance and motion of quantum circular vortexes. (M.P.G.)

36461 PERSISTENT CURRENTS IN He II. David Depatie, John D. Reppy, and C. T. Lane (Yale Univ., New Haven). p.75-6 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

Experiments are described that prove the existence of persistent currents in He II. The currents are large compared to the circulation about a single quantized vortex line. An Andronikashvili mica disc assembly was used, with the liquid contained in doubly connected annular regions or in simply connected regions. Experimental results show that the doubly connected geometry is not necessary for the existence of persistent currents. Results also indicate that the mutual friction must cut off below a certain relative velocity even though vortex lines are present. (M.P.G.)

36462 SUPERFLUID CIRCULATION IN LIQUID He. D. J. Griffiths (Univ. of British Columbia, Vancouver, Can.). p.77 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

An experiment to measure the superfluid circulation about a solid body in liquid He II is described. A quartz fiber weighted at its lower end was suspended vertically in a horizontal superfluid wind tunnel, which was open at one end and closed at the other by a heater. Circulation about the fiber deflected the fiber sideways, normal to the direction of the superfluid stream. The sensitivity of the experiment permitted one quantum of circulation to be visually detected with a superfluid velocity of ~0.01 cm/sec. Random jerky movements and smaller steadier fluctuations of the fiber were observed. The random movements were explained in terms of vortex lines, and the small fluctuations were produced by variations in the superfluid velocity. No critical heat input for turbulence was observed. (M.P.G.)

36463 TRANSPORT PROCESSES AT LOW TEMPERATURES: He II AND SUPERCONDUCTIVITY. L. Blum (Facultad de Ciencias Exactas y Naturales, Buenos Aires). p.78-9 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

The effective Hamiltonian of the phonon spectra of superfluid He and the effective Hamiltonian of superconductivity are substituted in the transport equation. They are shown to give vanishing contributions, meaning that no relaxation can take place. It is assumed that the perturbation series converges, that the system is spatially homogeneous, that the Fourier transform of the potential is finite, and that the collisions are much faster than the system's relaxation. (M.P.G.)

36464 MACROSCOPIC MODES OF He II. J. K. Percus (Courant Inst. of Mathematical Sciences, New York). p.80-1 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

Equations for the excitations of many-body systems are developed and discussed, especially with respect to free-particle states, sound waves, and hydrodynamic modes. The results are applied to He II, a many-boson system, and information on the character of the high-lying macroscopically describable levels is obtained. (M.P.G.)

36465 STATISTICAL MECHANICS OF SUPERFLUIDITY. P. Résibois (Université Libre, Brussels). p.84-5 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

A statistical interpretation is applied to a two-fluid model for dilute imperfect Bose gases. Calculations are based on Bogoliubov's theory of the dilute Bose gas and Prigogine's nonequilibrium statistical mechanics. It is postulated that the expectation value of the 2 density operators should be identified with the superfluid part and normal part of the density, and justifiable results are obtained. (M.P.G.)

36466 DISCONTINUITY OF THE DRIFT VELOCITY OF IONS IN He II DIRECTED BY THE HEAT FLUSH EFFECT. G. Careri, S. Cunsolo, and M. Vincentini Missoni (Università, Rome). p.86-7 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

The heat flush effect is used to detect the discontinuity in the drift velocity of moderately hot ions in liquid He II.

The critical velocity was determined to be 5.2 ± 0.2 m/sec. This value and the curve of ion mobility versus electric field agree with the results of the time-of-flight method, justifying the assumption that the drag velocity of the ions by normal fluid is a constant. It is concluded that excitations are not directly produced from the superfluid. (M.P.G.)

36467 HELIUM IONS IN ROTATING HELIUM. G. Careri (Università, Rome), W. D. McCormick, and F. Scaramuzzi. p.88-9 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

The motion of thermal ions in rotating He under an applied electric field was studied by rotating 3 configurations of electric diodes containing liquid He below the λ point. The electric current was measured as a function of the applied electric field, the temperature, and the rotational velocity. Rotating He was found to be anisotropic to the passage of the negative ion. The anisotropic "traps" for negative ions can be explained by the vortex lines theory. Different transient effects were observed, depending on the method used to change the rotational velocity of the electric field. (M.P.G.)

36468 PERIODICAL DISCONTINUITIES IN THE DRIFT VELOCITY OF IONS IN SUPERFLUID He. G. Careri, S. Cunsolo, and P. Mazzoldi (Università, Rome). p.90-1 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

The drift velocity of positive ions in liquid He at ~1°K was found to have a discontinuity at 5.2 ± 0.2 m/sec. Additional discontinuities were detected at velocities two, three, four, and five times the value of the first discontinuity. The first discontinuity could be due to the onset of inertial losses in the roton gas, and the multiplicity could be caused by coupling between the normal fluid and the superfluid, the superfluid velocity being quantized. Hysteresis phenomena were detected, which caused scatter of the data. A drift velocity discontinuity was also observed for negative ions, but at larger values than the one for positive ions. (M.P.G.)

36469 IONIC RECOMBINATION IN SUPERFLUID He AT SUPERCRITICAL VELOCITIES. F. S. Gaeta (Università, Rome). p.92 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

The formation of ionic currents in liquid He was studied using 2 plane parallel electrodes, one being coated with an α or β emitter. The ionic current density is plotted as a function of liquid He temperature for various applied electric fields. The density was found to increase sharply at a point that corresponds to the first discontinuity in the mobility of positive ions. The effects of decreased mobility and ionic recombination are apparently not sufficient to explain the sharp increase in current density. (M.P.G.)

36470 LAMINAR AND TURBULENT FLOW OF He II IN WIDE CAPILLARIES. F. A. Staas, K. W. Taconis, and W. M. van Alphen (Kamerlingh Onnes Laboratorium, Leiden). p.93-5 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

The turbulent and laminar flow of liquid He was studied in capillaries 173.5 and 255 μ in diameter. Two small vessels, one heated and the other in contact with a liquid He bath, are connected by a superleak and a capillary. Levels of liquid He in the vessels are indicated by manometer tubes. The onset of turbulence was determined by plotting the Reynolds number along the logarithmic abscissa and a coordinate for the pressure gradient along the logarithmic ordinate. With decreasing velocities, He II remained turbulent down to a Reynolds number of ~1200, the intersection of 2 straight lines on the pressure-velocity graphs. With increasing velocities, laminar flow can persist to a Reynolds number of ~6000 before a sudden jump to turbulence. (M.P.G.)

36471 THE EFFECT OF PRESSURE ON THE NORMAL COMPONENT VISCOSITY AND CRITICAL VELOCITIES OF LIQUID He II. D. F. Brewer (Oxford Univ.) and D. O. Edwards. p.96-7 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

Heat conduction by liquid He II in capillary tubes was studied at the vapor pressure and higher pressures up to the melting curve. The normal component of viscosity, the roton viscosity, and the critical superfluid velocity were recalculated using new entropy data and were found to be appreciably different from earlier values. The pressure dependence of the normal component of viscosity was found to be a monotonic function of density at all temperatures down to 1.14°K. New values of the roton viscosity do not increase rapidly with density as the previous values did. The critical velocity increases with density a little faster than it did in earlier calculations. (M.P.G.)

36472 ATTENUATION EXPERIMENTS BY MEANS OF SECOND SOUND HELMHOLTZ RESONATORS. T. M. Wiarda and H. C. Kramers (Kamerlingh Onnes Laboratorium, Leiden). p.98-9 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

The flow of He II through capillaries was studied by observing the attenuation of second sound. Part of the capillary was used as the inductive and resistive part of a Helmholtz resonator. Two small chambers on each end of a short capillary were used for the capacitive part, which also contained a heater and thermometer for generation and detection of second sound. Two types of simultaneous superfluid flow were studied, one in which the capillary is closed at its bath end and the other in which the flow of superfluid is not constrained. Results with the first type of flow are in good agreement with other researchers. With the superfluid not constrained, a critical Reynolds number of 1200 was observed for temperatures >1.4°K. Above the critical number, the attenuation coefficient for second sound increased much more rapidly than below the critical number. (M.P.G.)

36473 CRITICAL HEAT CURRENTS IN LIQUID He II. C. E. Chase (Massachusetts Inst. of Tech., Lexington). p.100-1 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

Critical heat current densities in liquid He II were measured in circular channels, 0.080 to 0.402 cm in diameter, up to the λ point. Measurements were made by the Vinen technique, observing the effect of small heat currents on the time required for equilibrium when a larger current is switched on. Directly observed values of current density in the smallest channel were in complete agreement with the Vinen values. The temperature dependence of the critical heat current density is shown graphically. A critical Reynolds number, which is a function of total density, channel diameter, and normal fluid velocity and viscosity, is also graphed as a function of temperature. Below ~1.6°K this Reynolds number has a value close to the classical value of 2300 and is nearly independent of temperature. It is suggested that critical heat currents at these temperatures are connected with a classical type of turbulence involving the normal or total fluid instead of just the superfluid. (M.P.G.)

36474 DETERMINATION OF THE COEFFICIENT OF MUTUAL FRICTION BETWEEN THE SUPERFLUID AND NORMAL COMPONENTS ALONG VORTEX LINES. Dzh. S. Tsakadze (Inst. of Physics, Tiflis, USSR). p.104-5 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

The coefficient of mutual friction between the superfluid and normal components of He II along the vortex lines was measured. The damping of cylinder oscillations along the axis of rotation should increase with increasing velocity of rotation if the coefficient is not equal to zero. In the described experiments it was found that the damping was independent of the velocity of liquid rotation for angular velocities from 0 to 0.2 sec^{-1}. This shows that there is no mutual friction parallel to the axis of rotation. Additional experiments show that oscillations of vortex lines by transverse waves running along them lead to nonzero values of the effective mutual friction. (M.P.G.)

36475 MACROSCOPIC QUANTIZATION IN SUPERCONDUCTORS. D. Bohm (Univ. of London). p.109-15 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

Experimental facts concerning macroscopic quantization of flux are reviewed. The experiments confirm present explanations of superconductivity, including the predicted pairing of electrons. Theoretical work on flux quantization is discussed. The author feels that quantization is best explained in terms of pair wave functions with a macroscopic number of pairs in the same angular momentum state. The dependence of the behavior of free electrons on flux outside the region accessible to them is analyzed. An analogy is drawn between flux quantization and dislocations in a crystal. (M.P.G.)

36476 QUANTIZED MAGNETIC FLUX IN SUPERCONDUCTING CYLINDERS. B. S. Deaver, Jr., and William M. Fairbank (Stanford Univ., Calif.). p.116 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

Improved apparatus for observing quantized magnetic flux trapped in hollow superconducting cylinders is described. A superconducting cylinder containing trapped flux is placed in half of a superconducting coil, causing current to flow in the coil to maintain the initial value of flux. The half of the coil not containing the cylinder is wound around a superconducting post, which also has a secondary coil. The post can be periodically heated to go into its normal state, thereby modulating the flux and causing a signal in the secondary coil. The cylinder can be moved into the coil with a micrometer, and the spot where a single flux unit leaves the cylinder can be observed exactly. (M.P.G.)

36477 CRITICAL PERSISTENT CURRENT IN SUPERCONDUCTORS. J. E. Mercereau and T. K. Hunt (California Inst. of Tech., Pasadena). p.117-18 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

Experiments to measure the currents due to the trapped flux in cylindrical superconductors are described. A strip of tin evaporated onto a quartz tube is suspended by a quartz torsion fiber. After a small "trapping" field was applied perpendicular to the plane of the ring, the ring was cooled below the superconducting transition, and the magnetic field was removed. The current due to the trapped flux was determined by measuring the deflecting torque on the ring in a known small magnetic field. Deflection of the ring was found to decrease as the ring warmed up. Graphs are presented of the behavior of critical currents in bulk and thin-film rings as the temperature approaches the transition temperature. Near the transition temperature, the current vs temperature curve deviates from linear and is proportional to the $^3/_2$ power of the difference between the critical temperature and the measurement temperature. An apparent saturation in critical current density was observed for thin-film samples at very low temperatures. (M.P.G.)

36478 MOMENTUM VORTICES AS POSSIBLE MECHANISM OF HYSTERESIS IN 'HARD' SUPERCONDUCTORS. G. B. Yntema (United Aircraft Corp., East Hartford, Conn.). p.119-20 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

A spatial structure for hard superconductors is hypothesized, and the resulting bulk properties are qualitatively described. It is suggested that hard superconductors contain arrays of closely spaced weak vortices in the flow of canonical momentum. These are shown to account qualitatively for superconduction in strong magnetic fields, for the penetration of magnetic intensity into bulk superconductors, for magnetic hysteresis, and for large specific heat in strong fields. (M.P.G.)

36479 THE BEHAVIOUR OF SUPERCONDUCTIVE ALLOYS AND HARD TRANSITION ELEMENTS. C. J. Gorter (Kamerlingh Onnes Laboratorium, Leiden). p.121-2 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

The behavior of superconductive alloys and hard transition elements can be explained by assuming that they split up into thin superconductive and normal regions in high magnetic fields. A provisional analysis of this model is presented, applying London's equations to the superconductive regions and using Mendelssohn's sponge model to explain supercurrents. Several properties of superconducting alloys and hard transition elements are accounted for with this analysis. (M.P.G.)

36480 QUANTUM PERIODICITY IN THE TRANSITION TEMPERATURE OF MULTIPLY-CONNECTED CONDUCTORS IN A MAGNETIC FIELD. W. A. Little and R. D. Parks (Stanford Univ., Calif.). p.129-31 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

The magnitude of the periodic variation in the transition temperature (the temperature at which the free energy of the normal and superconducting states are equal) is calculated. Under certain conditions the variation is large enough to be measured, $\sim 10^{-5}$°K. The transition temperatures of Sn, In, and Pb cylinders were measured as a function of the magnitude of an axial magnetic field. Excellent agreement with theory was obtained. The minima of the periodic parabolic variations lie at values of the field corresponding to integral units of the flux in the cylinder. (M.P.G.)

36481 SUPERCONDUCTIVITY AND ITS RELATION TO TRANSITION ELEMENTS. B. T. Matthias (Bell Telephone Labs., Murray Hill, N. J. and Univ. of California, San Diego, La Jolla). p.135-8 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

Since the transition elements do not appear to follow the same mechanisms of superconductivity as the nontransition elements, the theory of superconductivity has had to be reexamined. Electron-phonon interaction cannot explain the occurrence of superconductivity in transition elements, and a magnetic interaction, a spin exchange between the conduction electrons and the metal ions, is proposed. The influence of Fe impurities in superconductors and other experimental facts indicate that the mechanism of super-

conductivity is a magnetic interaction. Recent work shows that superconductivity is a more general phenomenon than ferromagnetism. (M.P.G.)

36482 SUPERCONDUCTIVITY OF TRANSITION METALS UNDER PRESSURE. E. Bucher and J. L. Olsen (Eidgenossische Technische Hochschule, Zurich). p.139 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

Superconductivity in transition metals is of a different kind from that in nontransition metals. In transition metals the isotope effect is absent, there is a different constant of proportionality in the relationship between the transition temperature and the critical field, and the effect of pressure on the transition temperature appears to obey different rules. Data on the volume dependence of the transition temperature show a definite difference between the 2 classes of superconductors. (M.P.G.)

36483 SUPERCONDUCTIVITY WITH COMBINED PARALLEL AND ANTIPARALLEL SPIN PAIRING. N. R. Werthamer, H. Suhl, and T. Soda (Univ. of California, San Diego, La Jolla). p.140-2 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

Interparticle potentials in superconductivity are analyzed, allowing pairs with both even and odd angular momentum and both singlet and triplet spin states. Green's functions are used in Gor'kov's formalism (J. Exp. Theor. Phys., 4: 735(1958)). Although the form of the potential does not agree with experiment, energetically favorable states with pairs of both even and odd parity are not inconceivable. (M.P.G.)

36484 SUPERCONDUCTIVITY WITHOUT ELECTRON-PHONON INTERACTIONS. James W. Garland (Univ. of Chicago). p.143-5 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

A formal theory of superconductivity is constructed, which is based solely upon electron-electron interactions. The heavy d-electrons contribute to the interaction kernel between conduction electrons, and Coulomb interactions are screened by the wave number and frequency-dependent dielectric constant. A simple model for transition metals is proposed, in which s-electrons are considered to be nearly free and d-electrons tightly bound. The model was found to admit superconductivity. The absence of the isotope effect and the pressure dependence of the transition temperature in transition elements appear logically in the proposed theory. (M.P.G.)

36485 FERROMAGNETISM VERSUS SUPERCONDUCTIVITY OF THE TRANSITION ELEMENTS, PARTICULARLY ALLOYS OF CHROMIUM AND IRIDIUM. B. T. Matthias (Bell Telephone Labs., Murray Hill, N. J. and Univ. of California, San Diego, La Jolla). p.146 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

The simultaneous occurrence of ferromagnetism and superconductivity does not occur in solutions of the transition elements. Hexagonal close-packed alloys of Cr and Ir are superconducting. Slight changes from cubic to hexagonal close-packed structures have been observed to cause a change from ferromagnetism to superconductivity, indicating a similarity in the mechanisms responsible for the 2 phenomena. (M.P.G.)

36486 FACTORS AFFECTING SUPERCONDUCTIVITY IN ALLOYS WITH UNFILLED D-BANDS. R. D. Blaugher (Westinghouse Electric Corp., Pittsburgh), J. K. Hulm, J. A. Rayne, B. W. Veal, and R. A. Hein. p.147-8 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

The heat capacity of Nb–Mo alloys was measured to test quantitatively the theoretical relation between the superconducting transition temperature, the density of states at the Fermi surface, and the Debye temperature. Experimental results are summarized. The Debye temperature was found to vary monotonically between the values for pure Nb and pure Mo. The coefficient of the electronic heat capacity passes through a shallow minimum near 70% Mo or 5.7 valence electrons/atom. The transition temperature passes through a deep minimum near the same composition. This is consistent with the BCS theory (Bardeen et al., J.R. Phys. Rev., 108: 1175(1957)), except for the assumption of a constant electron-electron interaction parameter. (M.P.G.)

36487 SUPERCONDUCTIVITY IN LANTHANUM ALLOYS. A. R. Mackintosh (Iowa State Univ., Ames). p.149-50 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

The variation of the parameter N(0)V, where N(0) is the density of states at the Fermi surface and V is an average electron-electron interaction matrix element, is plotted as a function of concentration for Mo–Nb, La–Lu, and La–Y alloys. In the La alloys, N(0)V varies slowly and almost linearly with concentration, and the variation is probably primarily due to changes in V. Linear extrapolations of the curves yield transition temperatures for Lu and Y of ~0.3 and 0.01°K, respectively. Pure Lu was found to be nonsuperconducting down to 0.35°K. (M.P.G.)

36488 ELECTRONIC SPECIFIC HEAT AND SUPERCONDUCTIVITY OF Nb–Ru ALLOYS. E. Bucher, J. Muheim, and J. Mueller (Eidgenossische Technische Hochschule, Zurich). p.151-2 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

The coefficients of electronic specific heat, γ, and transition temperatures, T_c, of Nb–Ru alloys were measured and plotted as a function of the mean electron concentration. T_c falls below 1°K in the region of 5.4 electrons/atom but reappears near 6.2. The parameter $N(0)V/\gamma$, where N(0) is the density of states and V is the interaction energy, was calculated and plotted. Results suggest that V increases steadily with increasing electron concentration in the region from 5 to 6 valence electrons, if γ and N(0) are proportional. (M.P.G.)

36489 SUPERCONDUCTIVITY AND ELECTRONIC PROPERTIES OF BINARY COMPLEX PHASES OF THE TRANSITION METALS. E. Bucher, F. Heiniger, and J. Mueller (Eidgenossische Technische Hochschule. Zurich). p.153-4 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

The critical temperatures of ~40 transition-metal alloys in complex phases with σ or α Mn structures are plotted as a function of mean electron concentration. Compounds with 6.6 to 6.8 valence electrons/atom exhibit the highest critical temperatures. To determine if the high transition temperatures are associated with corresponding high densities of states, the low-temperature specific heat, γ, was investigated for some representative phases. There was no indication of a pronounced peak of the γ. The product of the density of states and the interaction energy divided by γ varies as much as γ. (M.P.G.)

36490 THE TRANSITION TEMPERATURE OF SUPERCONDUCTING FILMS CONTAINING PARAMAGNETIC ADDITIONS. R. Hilsch, G. von Minnigerode, and K. Schwidtal (Universität, Gottingen, Ger.). p.155-6 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

Thin films of alloys of superconducting and paramagnetic materials were made by "quenching condensation," which is simultaneously evaporating components from the vapor phase onto a substrate of low temperature. With films of superconducting elements containing paramagnetic transition metals in an atomic disperse distribution, a linear decrease of the transition temperature was observed with increasing concentration of added paramagnetic atoms. In bulk specimens, a very small decrease, and in some cases an increase, in transition temperature was observed. It was demonstrated that quenching condensation did not affect the paramagnetic impurities by measuring the transition temperature of Pb and La films with Gd additions. The slopes of the curves of transition temperature vs concentration of Gd atoms were the same. (M.P.G.)

36491 SUPERCONDUCTIVITIES NEAR IMPURITIES. D. R. Fredkin (Univ. of California, San Diego, La Jolla), J. S. Langer, B. T. Matthias, and H. Suhl. p.157-8 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

A microscopic theory of a very small superconducting region embedded in a nonsuperconducting material is formulated using Gor'kov's equations (Sov. Phys. JETP, 34(7): 505(1958)) for the normal and anomalous Green's functions. The equation for the critical temperature was found to be remarkably similar to that for the bulk superconducting state. The theory should be relevant to the phenomena of "hard" superconductivity. (M.P.G.)

36492 THE ISOTOPE EFFECT IN SUPERCONDUCTING TRANSITION METAL ELEMENTS AND COMPOUNDS. T. H. Geballe (Bell Telephone Labs., Murray Hill, N. J.). and B. T. Matthias. p.159-61 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

The compound Mo_3Ir and pure Mo were investigated for the isotope effect. Quenched samples of Mo_3Ir were prepared from enriched samples of Mo-92, -96, -98, and -100. Transition curves, the reciprocal of the change in frequency of the oscillating coil surrounding the sample as a function of temperature, were plotted. The midpoints of transition temperatures of the 10 samples (2 for each isotope and 2 for natural Mo) were plotted as a function of the mean mass of Mo_3Ir. The slope of the line through the points is $-1/3$, the slope for the normal isotope effect being $-1/2$. An intermediate isotope effect of $\sim -1/3$ was also observed for pure Mo. The significance of the intermediate isotope effect is briefly discussed. (M.P.G.)

36493 SUPERCONDUCTIVITY OF THE MOLYBDENUM BORIDES AND RELATED MATERIALS. G. K. Gaulé, O. Adlhart, and R. L. Ross (Army Electronics Research and Development Lab., Fort Monmouth, N. J.). p.162-5 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

The transition temperatures of transition-metal borides, especially NbB, MoB, and Mo_2B, were studied. The compounds were synthesized by reactive sintering or direct fusion. The transition temperatures are plotted as a function of the number of electrons/atom, n, and are compared with the highest values reported in the literature. The curve does not have peaks at n = 3, 5, and 7 as predicted by the Matthias rule. A peak occurs at n = 4 for NbB, and a valley occurs at n = 4.5 for MoB. The valley is extended to n = 5 for electron-beam-melted Mo_2B. Since metal-rich borides are characterized by 2 interleaved substructures, one containing only transition-metal atoms and the other only B atoms, electrons may not be shared between the substructures. If the transition temperatures are plotted against the number of electrons/transition-metal atom, there is a peak of the curve at n = 5 and a valley at n = 6. (M.P.G.)

36494 THERMAL CONDUCTIVITIES OF TANTALUM-NIOBIUM SINGLE CRYSTALS. A. F. Rice (Oxford Univ.). p.166-7 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

The thermal conductivities of mixed single crystals of Ta in Nb were measured from 1 to 4°K. The crystals show sharp resistive magnetic transitions and no detectable trapped flux. Graphs of normal thermal conductivities vs temperature were not linear for 3 samples, especially for $Ta_{71}-Nb_{29}$. Possibilities for this phenomenon are discussed. In the superconducting state, the thermal conductivities of 2 specimens exhibit pronounced maxima due to enhanced phonon conduction. The ratio of superconducting to normal thermal conductivities was calculated as a function of the ratio of temperature to transition temperature (T/T_c). The maxima and minima of all the alloys were at $T/T_c = 0.2$ and 0.4, respectively, which are the same as those for pure Ta and Nb. Below $T/T_c = 0.5$, the results disagree markedly with theory. (M.P.G.)

36495 ENERGY GAPS IN SOME HARD SUPERCONDUCTORS. Ivar Giaever (General Electric Research Labs., Schenectady, N. Y.). p.171-2 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

Films of Nb, V, and Ta were prepared to study energy gaps by means of electron tunnelling. The tunnelling curves resemble those for soft superconductors. The energy gaps extrapolated to 0°K are: $2\epsilon_{Nb} = 2.90 \pm 0.05$ Mev, $2\epsilon_V \sim 1.45 \pm 0.1$ Mev, and $2\epsilon_{Ta} = 1.35 \pm 0.05$ Mev. A set of current-voltage characteristics for a $Nb-Nb_2O_5-Sn$ sandwich are presented, showing a pronounced negative resistance corresponding to the gap in Sn. Graphs of the energy gap in Ta as a function of temperature and of the slope of the energy-gap curve agree very well with theoretical curves. Most of the results can be explained by assuming a much larger smearing of the energy gap than that found for soft superconductors. Films of Bi and Pb and of Sn and Pb show 2 energy gaps corresponding to the 2 phases present. (M.P.G.)

36496 MEASUREMENTS OF THE ENERGY GAP IN SUPERCONDUCTING TANTALUM SINGLE CRYSTALS. I. Dietrich (Siemens and Halske A. G. Forschungslaboratorium, Munich). p.173-4 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

Single-crystal Ta samples were prepared to study the anisotropy of the energy gap for different crystallographic directions. The voltage-current characteristics of $Ta-Ta_xO_y-Pb$ sandwiches are presented for 3 crystallographic orientations. Although the shapes of the characteristics differ, the sum of the energy gaps of Ta and Pb determined from the curves is identical at the same temperature. The characteristics of a polycrystalline Ta sample are also presented. The temperature dependence of the energy gaps of the polycrystalline samples is consistent with that of the single crystals and with theory. No anisotropy of the energy gap due to crystallographic orientation was observed. (M.P.G.)

36497 THE TUNNEL EFFECT ON SINGLE-CRYSTAL TIN. N. V. Zavaritskii (Inst. for Physical Problems, Moscow). p.175 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

The current-voltage characteristics of $Sn_{film}-Sn_{oxide}-Sn_{crystal}$ sandwiches were measured. When the normal to the surface of the Sn crystals deviated from the [001] ori-

entation, several separated jumps in the current-voltage characteristics were observed. Possible explanations for this are discussed. The results were obtained at 1.36°K and not at higher temperatures. (M.P.G.)

36498 TUNNELLING IN SUPERCONDUCTING Nb_3Sn. T. Seidel and A. W. Wicklund (RCA, Princeton, N. J.). p.176-7 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

Current voltage characteristics at 4.2°K were determined for Nb_3Sn-Nb_3Sn oxide and normal metal sandwiches. The normal metals were In, Sn, and Cu. The measured current could not be entirely due to tunnelling, indicating that there must be a partial superconducting short. An energy gap for Nb_3Sn with a value of 1.8 kT_c was experimentally confirmed. To minimize the effect of pinhole shorts in energy-gap determinations, a metal that will not become superconducting should be used. (M.P.G.)

36499 SUPERCONDUCTIVE TUNNELLING. M. H Cohen, L. M. Falicov, and J. C. Phillips (Univ. of Chicago). p.178-9 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

Some theoretical questions associated with superconductive tunnelling are discussed, including the existence of highly nonlinear effects. The physical background of the separation of terms in the superconductor-oxide-normal metal Hamiltonian is treated first, and the tunnelling current is evaluated. Surprisingly strong nonlinear effects are found in the rapid decay of the strength of the fine structure and in multiphonon tunnelling. Tentative explanations of these nonlinear effects are presented. (M.P.G.)

36500 MEASUREMENTS OF THE SUPERCONDUCTING ENERGY GAP IN LEAD AND ALUMINIUM FILMS. D. H. Douglass, Jr., and R. H. Meservey (Massachusetts Inst. of Tech., Cambridge). p.180-1 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

The superconducting energy gaps were measured in thin evaporated films of Pb and Al by the electron-tunnelling technique. Graphs are presented of the energy gap vs temperature for an Al film 1220 Å thick, of the energy gap vs the theoretical function for the weak coupling limit for Al films 1220 and 3630 Å thick, and of theoretical and experimental values for the dependence of the energy gap on magnetic field at various temperatures for an Al film 3630 Å thick. The data indicate that energy-gap values are influenced more by film thickness than by transition temperature. The curves of the field-dependence of the energy gap are characteristic of a second-order phase transition, and good qualitative agreement was obtained between experimental and theoretical curves. A value of $2\epsilon_0 = 2.60 \times 10^{-3}$ ev was obtained for the energy gap in Pb at 0.9°K. (M.P.G.)

36501 AN INVESTIGATION BY ELECTRON TUNNELLING OF THE SUPERCONDUCTING ENERGY GAPS OF TANTALUM AND NIOBIUM. J. Sutton and P. Townsend (Plessey Co. Ltd., Towcester, Northants, Eng.). p.182-4 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

Bulk samples of Ta and Nb were used to form sandwiches with a thermally grown oxide for the potential barrier. Experimental curves of current-voltage characteristics for the Ta-barrier-Nb system are compared with theoretical points. The experimental and theoretical curves are similar, but a cusp near the low-voltage end of the negative-resistance region and a discontinuous rise in current at the high voltage end, which are predicted by the theory, do not appear in the experimental curves. The differences between theory and experiment must be due to an effective density of states in the superconductors different from theory. Possible mechanisms for this difference are discussed. The temperature dependence of the superconducting energy gap of Ta is in excellent agreement with theory over a wide temperature range. (M.P.G.)

36502 MAGNETIC FIELD DEPENDENCE OF THE ENERGY GAP IN SUPERCONDUCTORS. Yoichiro Nambu (Univ. of Chicago) and San Fu Tuan. p.185-7 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

The magnetic-field dependence of the energy gap in bulk material superconductors was studied using quantum field theory and a variational approach. It is assumed that the original BCS model is correct for the Meissner effect. Collective excitations are used to resolve the problems of gauge invariance encountered in previous analyses. The theory should be confronted with experiments. A method for applying bulk-material results to thin-film experimental data is suggested. (M.P.G.)

36503 ULTRASONIC MEASUREMENTS IN THREE SUPERCONDUCTING TRANSITION METALS. Moises Levy, Reynold Kagiwada, and Isadore Rudnick (Univ. of California, Los Angeles). p.188-90 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

Ultrasonic attenuation measurements on single crystals of V, Nb, and Ta are reported. Experimental data agreed with the BCS theory within $0.1kT_c$ for 135-Mc shear waves and 258-Mc longitudinal waves on V, assuming $2\epsilon_0 = 3.5kT_c$, where $2\epsilon_0$ is the energy gap at T = 0. Results for 225-Mc shear waves on Nb are best fit by a zero-temperature energy gap of $3.5 \pm 0.3kT_c$. Longitudinal measurements on Ta from 45 to 340 Mc result in an average zero-temperature energy gap of $3.5 \pm 0.1kT_c$. No discontinuities near the transition temperature were observed. Small departures from theoretical curves may be due to inhomogeneities in the acoustic field. (M.P.G.)

36504 ULTRASONIC ATTENUATION IN SUPERCONDUCTING VANADIUM AND ZINC. H. V. Bohm and N. H. Horwitz (Wayne State Univ., Detroit). p.191-2 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

The absorption of longitudinal sound waves of megacycle frequency was measured in superconducting V and Zn. Values of the superconducting energy gap obtained with the use of the BCS model were found to be anisotropic with respect to crystallographic direction. Values of the energy gap for V varied from 3.1 to 3.4 ± 0.2 kT_c, and values for Zn varied from 3.4 to 3.8 ± 0.2 kT_c, depending on crystallographic direction. No oscillation of the ultrasonic attenuation as a function of temperature below T_c was observed. The experimental problems entailed in working at the relatively high transition temperature (5.23°K) of V and the low transition temperature (0.85°K) of Zn are discussed. (M.P.G.)

36505 ULTRASONIC ATTENUATION IN SUPERCONDUCTING ALUMINIUM. R. David and N. J. Poulis (N. V. Philips' Gloeilampenfabrieken, Eindhoven, Netherlands and Kamerlingh Onnes Laboratorium, Leiden). p.193-4 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

The attenuation of longitudinal and shear ultrasonic waves in single crystals of Al was measured for different polarization directions with respect to the crystal axes. The zero-temperature energy gap for longitudinal waves was estimated to vary from 3.6 to 3.8 kT_c depending on frequency. No gap anisotropy was observed. The measured

absorption vs temperature curve was lower than the theoretical one for temperatures slightly less than the critical temperature. It is suggested that this could be caused by a small contribution to absorption from electromagnetic interaction. Graphs of shear-wave absorption are presented. The absorption due to electron-phonon interaction and that due to electromagnetic interaction are plotted separately. The latter increases more rapidly with frequency than the former. For shear waves the zero-temperature energy gap was estimated to be 3.4 to 3.5 kT_c. (M.P.G.)

36506 ULTRASONIC DETERMINATION OF THE ENERGY GAP IN SUPERCONDUCTING NIOBIUM. E. Roland Dobbs and John M. Perz (Royal Society Mond Lab., Cambridge, Eng.). p.195-6 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

The energy gap at 0°K of superconducting Nb, the temperature dependence of the energy gap, and the critical field curve were measured by the ultrasonic method. The energy gap was determined to be $3.96 \pm 0.1\ kT_c$, which agrees with values determined from thermal capacity data, from thermal conductivity measurements, and by electron tunnelling. It is higher than the theoretical BCS value and the infrared absorption value. The temperature dependence of the energy gap was found to be slightly larger than the predicted values at all temperatures. The critical field curve measured by the ultrasonic method was in agreement with that determined by other techniques. A vacuum-grown single crystal of pure Nb was found to show the wide transitions of a "hard" superconductor. (M.P.G.)

36507 ELECTRODYNAMICS OF AN ELECTRON GAS IN A UNIFORM MAGNETIC FIELD. John J. Quinn and Sergio Rodriguez (RCA, Princeton, N. J.). p.206-7 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

The response of an electron gas in a d-c magnetic field to an electromagnetic wave is studied theoretically. The conductivity tensor of an electron gas in a magnetic field is derived by means of quantum mechanics. A metal is assumed to be a free electron gas with a uniformly distributed background of positive ions in a cubic box. The conductivity tensor is shown to be independent of the gauge defining the electromagnetic potentials. The real and imaginary parts of the conductivity tensor are proportional to the velocity and attenuation of a longitudinal acoustic wave. The velocity of sound is shown to have oscillations that are a function of the magnetic field and have a period inversely proportional to the magnetic field. For high magnetic fields, the attenuation also has a periodic behavior depending upon the magnetic field, with amplitude proportional to the magnetic field and period inversely proportional to it. (M.P.G.)

36508 THE THERMAL PROPERTIES OF GADOLINIUM TRICHLORIDE NEAR ITS CURIE POINT. M. J. M. Leask, W. P. Wolf, and A. F. G. Wyatt (Oxford Univ.). p.230-1 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

Thermal measurements on anhydrous $GdCl_3$ are reported, confirming the transition to a ferromagnetically ordered state at 2.20°K. Specific heat measurements were made between 1.2 and 3.0°K by the standard electrical heating method. A pronounced peak in the specific heat was found at 2.20 ± 0.02°K. Above this temperature, the specific heat drops rapidly and then decreases slowly and smoothly with increasing temperature. This suggests a simple second-order phase change at 2.20°K. The results are reasonably well explained by a simple molecular field model of exchange and magnetic dipole interactions. (M.P.G.)

36509 ANTIFERROMAGNETIC SPIN ORDERING BELOW 1°K. W. T. Duffy, Jr. (Kamerlingh Onnes Laboratorium, Leiden), J. Lubbers, H. Van Kempen, T. Haseda, and A. R. Miedema. p.245-7 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

The susceptibility of a spherical single crystal of $GdCl_3 \cdot 6H_2O$ was measured by adiabatic demagnetization, and the specific heat below 1°K was also determined. Results indicate that antiferromagnetic ordering in $GdCl_3 \cdot 6H_2O$ is caused by a combination of crystalline field splittings and dipolar interactions. The specific heats of 3 Ni hexamine halides (Cl, Br, and I) were measured between 0.1 and 1.5 1.5°K. The experimental values for the Curie-Weiss constant divided by the transition temperature were appreciably larger than those predicted from a simple molecular field model. The specific heat and susceptibility of single crystals of $Cu(NH_3)_4SO_4 \cdot H_2O$, $CuSO_4 \cdot 5H_2O$, and $CuSeO_4 \cdot 5H_2O$ were measured. The results are in fair agreement with theoretical calculations on the properties of an isolated antiferromagnetic linear chain with isotropic exchange interaction. The specific heat of $K_3Fe(CN)_6$ was measured below 1°K, and the results are compared with theory. A surprisingly large difference was observed in the data on Cu salts compared to the K ferricyanide data. (M.P.G.)

36510 ELECTRONIC PROPERTIES OF THE ACTINIDE METALS. J. A. Lee (Atomic Energy Research Establishment, Harwell, Berks, Eng.) and G. T. Meaden. p.262-3 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

The thermoelectric powers of Th, U, Np, and Pu were measured down to 20°K. The results are plotted as functions of the temperature. The thermoelectric powers of Pu and U are large and positive at room temperature and nearly linear over a wide range of temperature. The thermoelectric power of Pu ceases to be linear at ~100°K, rises to a maximum at 75°K, and then falls rapidly for lower temperatures. This behavior is compared to that of the electrical resistivity and discussed in terms of antiferromagnetism and phase changes. The thermoelectric powers of Th and Np are negative at room temperature and are smoothly varying functions of temperature. (M.P.G.)

36511 A STUDY OF THE MAGNETIC PROPERTIES OF GOLD IN ALLOYS WITH IRON, COBALT AND NICKEL AT 4°K BY THE RECOIL-LESS RADIATION METHOD. Louis D. Roberts (Oak Ridge National Lab., Tenn.) and J. O. Thomson. p.267-8 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

The hyperfine structure of the 77-kev γ transition between the ground and first excited states of ^{197}Au was studied by the Mössbauer method using a neutron-activated Pt source. The magnetic moment of the ground state was found to be 0.1439 nm, and the quadrupole moment was 0.56×10^{-24} cm^2. The transmission of the 77-kev γ radiation through ½ at. % Au in Fe, 1 at. % Au in Co, and 1 at. % Au in Ni was determined as a function of the velocity of the absorbers. Results show that the magnetic polarization of the Au atom is proportional to the atomic magnetic moment of its host. The isomer shift is constant for these alloys. The isomer shift was measured for the complete composition range of the Au–Ni system at 4.2°K. (M.P.G.)

36512 ASYMMETRY OF β-EMISSION OF ^{114}In, ^{186}Re AND ^{192}Ir NUCLEI ORIENTED IN IRON ALLOYS. A. V. Kogan, V. D. Kulkov, L. P. Nikitin, N. M. Reinov, and M. F. Stelmakh (Academy of Sciences, Moscow). p.271 of

"Low Temperature Physics." Washington, D. C., Butterworths, 1963.

To determine the value and sign of the internal magnetic field H_{eff} acting at atomic nuclei, the asymmetry of β radiation of ^{114}In, ^{186}Re, and ^{192}Ir nuclei polarized in solid solutions of Fe was measured at very low temperatures. The investigated elements did not exceed 0.1% the weight of the alloy. The sign of H_{eff} was negative for all the nuclei, and the products of the magnetic moment and H_{eff} are tabulated. (M.P.G.)

36513 SPIN-LATTICE RELAXATION IN SOME SALTS OF COBALT AND OF THE RARE EARTHS. L. C. Van Der Marel, J. C. Verstelle, and C. J. Gorter (Kamerlingh Onnes Laboratorium, Leiden). p.286-8 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

Paramagnetic relaxation measurements were made on Co and rare-earth salts at liquid He and H temperatures. Magnetic fields with constant and alternating components were applied to the samples. Audio frequency magnetic fields were used at He temperatures, and frequencies from 0.6 to 100 MHz were used at H temperatures. The samples used were $Co(NH_4)_2(SO_4)_2 \cdot 6H_2O$, $Co(Cs)_2(SO_4)_2 \cdot 6H_2O$, and $R(C_2H_5SO_4)_3 \cdot 9H_2O$, where R is a rare-earth ion with an odd number of electrons in the 4f shell. Graphs of the relaxation parameters as functions of temperature are presented, and the results are discussed. (M.P.G.)

36514 SPIN-PHONON INTERACTIONS IN UO_2-NEUTRON IRRADIATION EFFECTS. Olivier Bethoux, Pierre Thomas, and Louis Weil (Université, Grenoble, France). p.304-5 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

The thermal conductivity between 3.5 and 10°K of natural sintered UO_2 was measured before and after room-temperature neutron irradiation. Experimental results are plotted as a function of temperature showing a thermal-conductivity minimum near 31°K. The thermal conductivity is affected by irradiation much more below 30°K, the Neel point temperature of UO_2, than above, even for doses as small as 5.7×10^{15} thermal neutrons/cm^2. A theoretical analysis of the experimental results is presented. A reasonable quantitative estimation of irradiation defects can be obtained from thermal-conductivity measurements above the Neel point. A much more complicated theory is required to obtain quantitative information below the Neel point. (M.P.G.)

36515 APPLICATIONS OF LOW TEMPERATURE PHENOMENA: A SURVEY. J. M. Lock (Cornell Univ., Ithaca, N. Y.). p.313-20 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

The development of superconducting switches, or cryotrons, is reviewed. The problems of current gain, the ability to switch rapidly, and reliability are discussed. The use of cryotrons in computers has been delayed because of reliability, but cryotron development now depends more on technology than low-temperature physics. The cryosar is a low-temperature device, which may be used as a bistable memory element in computers. The cryosar utilizes the phenomenon of impact ionization of impurities in Ge. The development and operation of cryosars are discussed. The study of high-critical-field superconductivity in alloys and compounds is also reviewed. (M.P.G.)

36516 R.F. DETECTION BY ELECTRON TUNNELLING BETWEEN SUPERCONDUCTORS. Sidney Shapiro and Andre R. Janus (Arthur D. Little, Inc., Cambridge, Mass.). p.321-3 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

The use of a superconducting tunnelling assembly to demodulate an a-m signal at frequencies up to 65 Mc is described. The tunnelling samples consisted of vacuum-deposited films of Al and Pb separated by a thin layer of Al oxide. Experiments were carried out at temperatures of 4.2°K or lower. The results of various experiments are presented, and a theory is developed that agrees with experimental observations. (M.P.G.)

36517 HIGH POWER SUPERCONDUCTING CAVITIES FOR ACCELERATORS. William M. Fairbank, John M. Pierce, and Perry B. Wilson (Stanford Univ., Calif.). p.324-5 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

Measurements of the Q of Sn and Pb cavities with fields greater than $1/10$ of the critical field are described. For the Pb cavity, the highest Q measured was 4×10^8 at 1.79°K, which is more than 10^3 times the Q of an identical Cu cavity at room temperature. The Q was found to be independent of the power coupled into the cavity up to ~3 w, the highest power available. The use of superconducting cavities in linear accelerators would have the advantage of eliminating the low-duty-cycle limitations of conventional linacs, since lower-powered klystrons with continuous operation could be used. The duty cycle would be limited only by the cost of refrigeration. (M.P.G.)

36518 SUPERCONDUCTING CAVITIES AT 280 Mc/sec. J. Ruefenacht and L. Rinderer (Université, Lausanne, Switzerland). p.326-7 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

The study of semiclassical superconducting cavities with a resonance frequency of 283 Mc is reported. The cavities were made from different superconducting materials with different surface treatments. The frequency response method was used to determine the Q of the cavities. Q's as high as 8.6×10^8 were obtained with commercially pure Pb cavities at 2°K. A cavity of Pb alloy was found to be much less vibration-sensitive than the pure Pb cavity and had a Q of 6×10^8 with a resonant frequency of 260 Mc. Additional research on superconducting resonant cavities for proton linear accelerators is reported by A. P. Banford of the Rutherford Laboratory. (M.P.G.)

36519 NEW METHOD FOR MEASURING CHANGES IN SURFACE IMPEDANCE: APPLICATION TO SUPERCONDUCTING TIN AT X-BAND. M. S. Dresselhaus, D. H. Douglass, Jr., and R. L. Kyhl (Massachusetts Inst. of Tech., Cambridge). p.328-9 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

The variation of surface impedance with temperature and d-c magnetic field for normal or superconducting metals can be studied by a new technique, which is described. The technique is applied to the magnetic-field dependence of the surface impedance of superconducting Sn at X-band. A flat metal specimen is coupled to a resonant mode of a rectangular dielectric rutile resonator. Changes in surface reactance and resistance are measured directly with a "Smith chart plotter." Advantages of the new technique are described, and graphs of results are presented. The field dependence of the sample was found to be nonquadratic and nonmonotonic at some temperatures. Large anisotropy was found as the magnetic field was rotated in the plane of the sample. (M.P.G.)

36520 SUPERCONDUCTING SOLENOIDS FOR PRODUCING HIGH MAGNETIC FIELDS. H. Riemersma, J. K. Hulm, and B. S. Chandrasekhar (Westinghouse Electric Corp., Pittsburgh). p.330-1 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

Magnetic fields of 50 kG, and a field of 68 kG from one solenoid, were produced with solenoids wound with Nb–Zr wire. The coils have an ID of 0.3 to 2.5 cm, OD of 1.2 to 10.0 cm, and length of 5 to 7 cm. The proximity effect is discussed, and reasons are given for believing that the effect is associated with the coil configuration. Types of insulation and electrical joints used in the coils are described. Regions of instability where the coil tends to go normal were observed in some coils, and trapped flux in the solenoid windings was detected when the current in a coil was reduced from a high value to zero. When a coil goes normal, the magnetic field energy appears as joule heat, which may be a serious problem in larger coils. In Nb–Zr coils, the plateau critical current appears to decrease with increasing Zr content. A 68-kG solenoid was constructed of 6 sections, the 2 inside sections using an alloy of Nb + 33% Zr and the other sections using a 25% Zr alloy. (M.P.G.)

36521 THE GENERATION OF INTENSE MAGNETIC FIELDS WITH SUPERCONDUCTORS USING INDUCTION. Daniel D. Elleman and Alvin F. Hilderbrandt (California Inst. of Tech., Pasadena). p.332-3 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

The design and operation of a magnetic flux pump is described. A solid cylinder of Nb or sintered Nb_3Sn contains 2 cylindrical cavities with a slot milled between them. Two superconducting "valves" of Nichrome heating wire are embedded in the walls between the cavities and between one cavity and the outside region. The solid cylinder is cooled to 4.2°K in a magnetic field parallel to the cavities. By a cyclic operation of the valves, which make the material around them go normal, and a piston in one of the cavities to compress the flux, the field in the other cavity can be approximately doubled. In the Nb_3Sn cylinder, a final field of 23.5 kG was obtained in an external field of 1 kG by using Fe to concentrate the flux before compression. (M.P.G.)

36522 PROPERTIES OF A NEW TYPE OF PARALLEL CRYOTRON. J. F. Marchand (N. V. Philips' Gloeilampenfabrieken, Eindhoven, Netherlands). p.334-5 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

The design of a new cryotron is described, which consists of 2 parallel strips of Sn in the same plane simultaneously deposited on a glass substrate. The switching magnetic field is perpendicular to the plane of the strips. The resistance of the gate strip as a function of the control current changes abruptly from zero to a maximum with no tail or hysteresis. The gain of the cryotron increases with decreasing temperature and remains high at superfluid-He temperatures. The control strip can always be in the superconducting state. The gain is roughly proportional to the ratio of the width of the control strip to the width of the gate strip. The switching speed of the cryotron is briefly discussed. (M.P.G.)

36523 THE DEPENDENCE OF THE MICROWAVE IMPEDANCE OF A SUPERCONDUCTOR ON DIRECT CURRENT. J. I. Gittleman, B. Rosenblum, T. Seidel, and A. W. Wicklund (RCA, Princeton, N. J.). p.336-7 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

The microwave impedance of a superconductor was measured as a function of direct current to observe the increase in the quasi-particle population due to the presence of a current. Evaporated Sn films were mounted in a rectangular wave-guide cavity. A 1-kc square wave of current was passed through the sample, and the change in the 1-kc component of power reflected from the cavity with changes in the current amplitude was measured. The microwave frequency was ~55 kMc. Measurements were made at temperatures less than 2°K, so that the energy-gap parameter would not differ appreciably from its zero-temperature value. The signal, which is proportional to the imaginary part of the microwave impedance, is plotted below the critical current as a function of the square of the reduced current. When the sample becomes normal, the signal increases abruptly, due primarily to a change in the real part of the impedance, and remains constant for higher currents. The experimental results indicate that superconductivity is destroyed by a current when magnetic interactions are unimportant. (M.P.G.)

36524 GIANT ANISOTROPY IN THE HIGH FIELD CRITICAL CURRENTS OF COLD ROLLED TRANSITION METAL ALLOY SUPERCONDUCTORS. R. R. Hake, D. H. Leslie, and C. G. Rhodes (Atomics International, Canoga Park, Calif.). p.342-4 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

Extremely large changes in critical current with magnetic-field orientation were observed in cold-rolled alloys of superconducting transition metals. Anisotropy ratios (maximum current density/minimum current density) of 81 to 249 were measured in Ti-60 at.% Nb samples sheared from thick cold-rolled sheets at various angles to the rolling direction. Maximum current densities occurred when the transverse magnetic field made an angle of ~0° with the rolling direction of the sample. The results indicate that the current density in superconducting alloys is sensitive to the orientation of the defect structure with respect to current and magnetic-field directions as well as to the density of the lattice defects introduced by cold working. (M.P.G.)

36525 THE HIGH FIELD SUPERCONDUCTIVITY OF NIOBIUM–ZIRCONIUM ALLOYS. B. S. Chandrasekhar, M. S. Walker, H. Riemersma, and F. E. Werner (Westinghouse Electric Corp., Pittsburgh). p.345-7 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

The critical current in a cold-rolled strip of Nb–30% Zr in a 20 kG magnetic field is plotted as a function of the field direction about the axis of the sample. When the field is parallel to the rolling plane, the critical current is ~13 times as large as when the field is perpendicular. A flattened wire showed the same anisotropy as the strip. Heat treatment of the wire and strip increased the critical current. The anisotropy may be explained by the fact that grain boundaries in rolled strips and flattened wires are flat sheets parallel to the rolling plane. The critical currents in several Nb–Zr alloys in transverse magnetic fields were compared for short wire samples and long wire samples wound into a solenoid. The decrease in the current going from short samples to solenoids was large for 25% Zr alloys and almost absent for 50% Zr alloys. This proximity effect is discussed. (M.P.G.)

36526 CRITICAL CURRENT FOR Nb–Zr RIBBONS IN EXTERNAL MAGNETIC FIELD. V. D. Boroditch, A. C. Combarov, V. Ya. Filkin, A. P. Golub, M. G. Kremlev, N. C. Moroz, and B. N. Samoilov (Inst. for Physical Problems, Moscow). p.348 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

The critical currents in Nb-25 at.% Zr ribbons were measured in transverse magnetic fields up to 23.5 kG at 4.2°K. The critical current density was ~30 times as large for magnetic fields parallel to the surface of the specimen as it was for perpendicular fields. This indi-

cates that the current in cold-rolled samples is carried by thin films parallel to the rolled surface. The influence of annealing on the critical properties of Nb–Zr alloys was studied. Current densities are plotted as a function of annealing temperature. The current density for perpendicular fields rises suddenly for samples annealed at 500 to 750°C. Both the perpendicular and parallel current densities decrease for higher annealing temperatures, and the critical current anisotropy almost disappears. The structure of the annealed sample must change from films to an isotropic network of filaments. (M.P.G.)

36527 A. C. EXPERIMENTS ON HARD SUPERCONDUCTORS. R. A. Kamper and P. F. Chester (Central Electricity Research Labs., Leatherhead, Surrey, Eng.). p.349-50 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

Attempts were made to detect hysteresis losses in rings of Nb_3Sn and Nb–Zr alloys. Critical currents were induced by an alternating axial magnetic field. No detectable effect was observed in the rate of boil-off of liquid He containing the sample or in the phase angle between the current in the ring and the driving field. It is concluded that the self-inductance of the conductor causes an instability in the penetration of the current into the sample, which destroys the superconductivity. (M.P.G.)

36528 QUENCHING CHARACTERISTICS OF SURFACE-COATED Nb–Sn WIRES. L. Rinderer (Université, Lausanne, Switzerland) and J. Wurm. p.351-2 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

Alloys of Nb–Sn were prepared by surface diffusion of Sn into Nb wires of 0.5 mm diameter. The resulting wires had a Nb core, an inner layer ~5μ thick of the 2-phase system α + Nb_3Sn, and an outer layer 10 to 15μ thick of the mixed phase Nb_3Sn + Sn. The layers were prepared by heating in Sn vapor, diffusion in a Sn bath, and annealing in Sn vapor. If the outer layer is reduced by etching, the critical values of the quenching characteristic are considerably lower. Results indicate that the current-carrying filaments are composed of Nb_3Sn embedded in a Sn matrix and lie on the boundary between the inner and outer layer or in the outer layer near the boundary. The density of the filaments varies with the method of preparation of the sample. Current densities up to 2×10^5 amp/cm^2 with 30-kG transverse magnetic fields were obtained with samples heated in Sn vapor followed by diffusion in a Sn bath. (M.P.G.)

36529 THE EFFECT OF COMPOSITION ON THE SUPERCONDUCTING PROPERTIES OF VAPOUR-DEPOSITED NIOBIUM STANNIDE. J. J. Hanak, G. D. Cody, J. L. Cooper, and M. Rayl (RCA, Princeton, N. J.). p.353-4 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

Vapor-deposited Nb stannide has produced critical current densities as high as 5.6×10^5 amp/cm^2 in a transverse magnetic field of 90 kG. Large changes in the transition temperature and critical current density can be caused by variations in composition of the deposited material. Measurements of the lattice disorder of vapor-deposited and sintered Nb stannide suggest that disorder is associated with the changes in the transition temperature. A study of lattice site occupancy indicates that the occupancy of the Sn sites by Nb is responsible for the observed differences in transition temperature between sintered and vapor-deposited samples. (M.P.G.)

36530 MAGNETIC FIELD PENETRATION IN Nb_3Sn. G. D. Cody, J. J. Hanak, and M. Rayl (RCA, Princeton, N. J.). p.355-7 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

The penetration of a longitudinal magnetic field of variable amplitude and frequency into samples of Nb_3Sn was measured over the temperature range 4.2 to 18.2°K. The samples were wires of a nonsuperconductor coated with chemically deposited Nb_3Sn. The experimental setup is described. The change of inductance with temperature of a coil surrounding the sample is assumed to be associated with the penetration depth of the magnetic field in the superconductor. The penetration depth at zero temperature was determined to be 4040 Å, an order of magnitude larger than that for soft superconductors such as In, Sn, Pb, and Hg. The sources of error in the determination of the penetration depth are discussed. (M.P.G.)

36531 SUPERCONDUCTIVITY OF SOME SOLUTIONS BASED ON Nb_3Sn. R. Hagner and E. Sauer (Universität, Giessen, Ger.). p.358-9 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

The influence of the valence electron number per atom on transition temperature was studied in solid solutions prepared by replacing some of the Sn in Nb_3Sn by Ga, In, Tl, Ge, Pb, As, Sb, and Bi. An inductive method was used for the measurements. Graphs of transition temperature as a function of the amount of the substitute for Sn are presented. When some of the Sn is replaced by Ga, As, In, Tl, Pb, and Bi, solid solutions are formed with a transition-temperature maximum at 10 to 15% of the replacing element. A continuous decrease in the transition temperature with increasing amount of the replacing element was found for solid solutions with Ge and Sb. (M.P.G.)

36532 BOUNDARY EFFECTS BETWEEN A SUPERCONDUCTOR AND A NORMAL CONDUCTOR. Hans Meissner (Stevens Inst. of Tech., Hoboken, N. J.). p.365-7 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

Thin films of Sn were evaporated onto a Cu tube and a glass tube coated with an evaporated layer of Cu. The critical temperature was reduced more in the Cu-tube sample than in the glass-tube sample, indicating that the reduction is caused by drifting electrons rather than diffusing atoms. Experiments with Cu–Sn sandwiches show that the critical temperature decreases approximately exponentially with the Cu thickness until that thickness is larger than the mean free path. The critical temperature is then independent of further increase in Cu thickness. With layers of Sn evaporated on Mo, a critical-field increase of more than 10 times that of Sn deposited on glass was observed. The thin-film structures can produce very high critical fields and seem to be a model for hard superconductors. (M.P.G.)

36533 CRITICAL CONDITIONS FOR THIN SUPERCONDUCTING FILMS IN GINZBERG-LANDAU THEORY. Paul M. Marcus (International Business Machines Corp., Yorktown Heights, N. Y.). p.368-71 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

The one-dimensional Ginzberg-Landau equations for the magnetic behavior of superconductors are applied to thin films with the approximation of constant order through the film. Stable and metastable behavior are discussed using the film equation of state relating order to external fields. The phase-transition condition and stability limits are determined and plotted for films in equal and unequal tangential fields. Two sets of experiments are reported

by Dr. Fred Rothwarf of Frankford Arsenal, Philadelphia, indicating that bulk samples may have different dipole sheets becoming successively normal and superconducting. (M.P.G.)

36534 THE PHASE BOUNDARY MODEL OF SUPERCONDUCTING TRANSITION. Hirsh Cohen (International Business Machines Corp., Yorktown Heights, N. Y.). p.372-5 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

Calculations of superconducting transitions based on the phase boundary model are reviewed. In the model, eddy currents generated in the normal region control the motion of an interphase boundary. Extensions of the model to transitions in thin films are also discussed. For thin films, the critical field changes with the thickness of the superconducting region and with the symmetry of the applied fields. The constant critical field hypothesis is not correct for very thin superconducting regions, and a time-dependent form of the Ginzberg-Landau theory is needed. (M.P.G.)

36535 SUPERCONDUCTIVE FILMS OF THE TRANSITION METALS: NIOBIUM, TITANIUM AND VANADIUM MADE BY 'PROTECTED SPUTTERING.' Rudolf Frerichs and Charles T. Kircher (Northwestern Univ., Evanston, Ill.). p.376-7 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

The experimental arrangement and procedures used in preparing superconducting films of transition metals by "protected sputtering" are described. The sputtering takes place in an argon atmosphere. The glass plates on which the films are deposited from part of one of the electrodes, and an asymmetric alternating current is used for the sputtering. Bombardment of the newly deposited films with argon ions decomposes the impurities on the surface and makes the metallic layers shiny. Very hard layers of Nb, Ta, and V have been prepared, and results obtained with the films are tabulated. (M.P.G.)

36536 SUPERCONDUCTING VANADIUM THIN FILMS. H. van Beelen, R. de Bruyn Ouboter, J. J. M. Beenakker, and K. W. Taconis (Kamerlingh Onnes Laboratorium, Leiden). p.378-9 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

Thin films of V were prepared by evaporating V from a W boat onto a glass substrate. The thickness of the films ranged from 130 to 800 Å. A graph of the residual resistance ratio as a function of critical temperature was found to be linear. The critical current was plotted as a function of the applied magnetic field for different film thicknesses. Current-density values were found to be sensitive to the type of electrical contacts used and to small external magnetic fields. The behavior of the critical current as a function of temperature was also studied. (M.P.G.)

36537 HARD SUPERCONDUCTOR EFFECTS IN SUPERIMPOSED METALS. B. Serin and G. K. Chang (Rutgers Univ., New Brunswick, N. J.). p.380 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

Intermetallic reactions occurring in superimposed metals near room temperature were found to affect the superconductive properties of films. Films of Sn on bulk Au and superimposed films of In and Pb of equal thickness were studied. Heating of Sn films on Au caused a progressive decrease of the transition temperature with time and an increasing initial slope of the curve of critical magnetic field vs temperature. When films of Pb and In were aged, the shape of the curve for the limiting current field became similar to those for hard superconductors. Aging may produce reasonably inhomogeneous alloys. Evidence was found that current is carried at the interface between the 2 metals. The total current increased rapidly with the number of interfaces but was independent of film thickness. (M.P.G.)

36538 THE SUPERCONDUCTIVITY OF SUPERIMPOSED Pb AND Cu FILMS. P. Hilsch, R. Hilsch, and G. von Minnigerode (Universität, Gottingen, Ger.). p.381-2 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

Strips of Cu and Pb were superimposed by condensation on a crystalline quartz substrate at 10°K. Care was taken to prevent oxidation between the films or absorption of residual gases. The transition temperature was found to depend on the thicknesses of both films and was always lower than the transition temperature of Pb. The experimental results are described by an empirical formula. The influence on the critical thickness of the superconducting film of the electron mean free path in the normal metal and the mean free path of the normal electrons in the superconducting film is discussed, and a qualitative model is proposed. (M.P.G.)

36539 LATTICE HEAT CAPACITY, ISOTOPE EFFECT AND SIMILARITY PRINCIPLE IN INDIUM. H. R. O'Neal, N. M. Senozan, and N. E. Phillips (Univ. of California, Berkeley). p.403-4 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

Heat capacity measurements on In were extended down to 0.08°K, and critical field measurements were made on ^{113}In and ^{115}In between 1.1°K and the critical temperature. The total heat capacity in the superconducting state was found to be as much as 10% less than the estimated lattice heat capacity for the normal state. Preliminary critical field data are presented illustrating the isotope effect near the critical temperature. It is shown that the similarity principle is obeyed within the accuracy of the experiments. Explanations of the difference in lattice heat capacity are discussed. (M.P.G.)

36540 LATTICE DYNAMICS OF ISOTOPIC MIXTURES. C. Domb, C. Isenberg, and C. Tripp (Univ. of London). p.413-14 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

Calculations of thermodynamic functions and their dependence on order are described, and preliminary results are reported. At high temperatures the Thirring series can be integrated to obtain a series expression for the free energy. Application of the Padé approximant to the series extends its applicability to temperatures ~0.05 of the equivalent Debye temperature. A low-temperature expansion is described, which permits calculation of the free energy of disordered and partially ordered one-dimensional chains over the entire temperature range. The equilibrium value of the order parameter was determined as a function of temperature. An alternative approach using a Monte Carlo method obtained results in good agreement with the first method. (M.P.G.)

36541 THE THERMAL CONDUCTIVITY OF SOLID ^{3}He AND SOLID ^{4}He. Michael J. Crooks and Henry A. Fairbank (Yale Univ., New Haven). p.417-18 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

The thermal conductivity of solid ^{3}He and ^{4}He was measured at temperatures of 0.5 to 1.1°K using a blocked-capillary technique. Graphs of thermal conductivity vs

temperature for a ^{4}He sample before and after annealing show that annealing raises the conductivity by a factor of almost 20 and shifts the maximum to a lower temperature, indicating a longer phonon mean free path. Graphs of thermal conductivity vs temperature for hexagonal close-packed and body-centered cubic samples of ^{3}He and graphs of phonon mean free path vs temperature are also given. (M.P.G.)

36542 DENSITY MEASUREMENTS IN SOLID ^{4}He. J. N. Kidder (Yale Univ., New Haven). p.419-20 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

The density of solid He was measured as a function of temperature and pressure by measuring the dielectric constant at microwave frequencies. The Clausius-Mossotti relation was used to calculate the density from the dielectric constant. The measuring apparatus is described. Data for density vs pressure for 6 constant temperatures between 1.45 and 1.73°K clearly show the melting point and solid phase transition. Volume changes for melting and for the solid transition and the thermal expansion coefficient of the solid were also determined. Sources of error are discussed. (M.P.G.)

36543 PVT RELATIONS IN ^{4}He NEAR THE MELTING CURVE AND THE λ LINE. R. L. Mills and E. R. Grilly (Los Alamos Scientific Lab., N. Mex.). p.421-2 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

Measurements were made of the pressure-volume-temperature melting and transition properties in the solid γ phase of ^{4}He and in liquid ^{4}He in the high-pressure region of the λ line. The experimental apparatus and procedures are briefly described. Pressure vs temperature measurements of the phase changes in condensed ^{4}He are plotted. The solid transition line intersects the melting curve at P = 25.93 atm, T = 1.437 ± 0.006°K and at P = 29.67 atm, T = 1.760 ± 0.004°K. The calculated slope of the transition line is 15 atm/deg. Curves of the volume change on melting and the thermal expansion and compressibility coefficients of liquid ^{4}He in the high-pressure region of the λ line are also given. (M.P.G.)

36544 STRUCTURE OF THE γ FORM OF SOLID ^{4}He. R. L. Mills and A. F. Schuch (Los Alamos Scientific Lab., N. Mex.). p.423-4 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

The crystal structure of the γ phase of ^{4}He was directly determined by x-ray diffraction. Experimental equipment and procedures are described. The structure of the γ phase was found to be body-centered cubic, and Laue reflections were indexed on the basis of a cubic lattice. The observed reflections had indexes of 110 and 200 with average interplanar spacings of 2.911 ± 0.009 and 2.053 ± 0.005 Å, respectively. The length of the cell edge is 4.11 Å, and the molar volume is 20.91 cm^3. Diffraction photographs were also taken of the hexagonal α phase of ^{4}He. The molar volume change on transition was found to be 0.21 cm^3. (M.P.G.)

36545 RECENT PROGRESS IN MAGNETIC COOLING WITH PARAMAGNETIC METALS. R. D. Parks (Stanford Univ., Calif.). p.427-9 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

Certain paramagnetic alloys remain magnetically disordered to very low temperatures making then suitable for magnetic cooling by adiabatic demagnetization. Th–rare earth alloys are probably the most suitable binary alloy for magnetic cooling to temperatures of 0.1 to 1.0°K. However, the superconductivity of the alloys makes it necessary to maintain a magnetic field for good thermal conductivity. This could saturate the electronic spin system and thus limit the useful temperature range. Other suitable alloys are La and Y containing 1% Dy. These alloys and Th–1% Dy are compared with respect to temperature of magnetic ordering, atomic diameter, the electronic configuration of the conduction electrons, and the electronic specific heat constant. The critical temperature differs by more than an order of magnitude between the Th and Y alloys, and an explanation of this is presented based on the configuration of the conduction electrons. Intermetallic compounds of noble metals and rare earths were also studied. Compounds of CuLaEr and AuLaEr were found to be still paramagnetic between 1.3 and 4.2°K, even with a high spin density. Similar compounds with lower spin densities should be useful for magnetic cooling. The thermal conductivities of the compounds are comparable to that of a Th–Er alloy. (M.P.G.)

36546 ROTATIONAL COOLING OF A COBALT NUCLEAR SPIN SYSTEM BY MEANS OF ANISOTROPIC HYPERFINE STRUCTURE COUPLING. W. J. Huiskamp, J. Lubbers, and P. Bloembergen (Kamerlingh Onnes Laboratorium, Leiden). p.430-1 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

A cooling procedure is described, utilizing the reduction in hyperfine structure (h.f.s.) energy splittings by rotation of ionic magnetic moments in crystals having anisotropic h.f.s. coupling. Co–Tutton salts, particularly $CoCs_2(SO_4)_2 \cdot 6D_2O$, with radioactive impurities of ^{54}Mn and ^{60}Co were used. The experimental arrangement and procedures are described. A final temperature of 0.012°K was derived from the data. This was higher than expected, and possible explanations are offered. It is concluded that nuclei with large magnetic moments are appreciable electric quadrupole coupling may be oriented by rotational cooling, preserving very low temperatures in the presence of large external magnetic fields. (M.P.G.)

36547 NUCLEAR ORIENTATION IN HOLMIUM AND TERBIUM METAL. M. A. R. Leblanc and W. T. Sommer (Stanford Univ., Calif.). p.432-4 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

Nuclear polarizations in single crystals of Ho and Tb were studied at various values of external magnetic field. An adiabatic demagnetization cryostat with superconducting magnets was used to measure the anisotropy of the metals. Single crystals were bombarded in a reactor to an activity of ~30 μC, and γ-ray emission was observed. Preliminary measurements show no significant anisotropies in Tb at 0.05°K for 5 γ-ray energies from 300 to 1280 kev. Anisotropies were observed in Ho, and the results are compared with theoretical predictions. (M.P.G.)

36548 THE GAMMA-RAY DISTRIBUTION FROM ORIENTATED CERIUM-141 AND ITS APPLICATION TO THERMAL CONTACT AT LOW TEMPERATURES. J. F. Schooley and D. D. Hoppes (National Bureau of Standards, Washington, D. C.). p.435-6 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

The γ-ray distribution from aligned ^{141}Ce was studied experimentally. The anisotropy was found to be larger than expected, but this may possibly be explained by scattering. The heat flow between adjacent Cr–K–alum and Nd ethylsulfate crystals was measured between 0.02 and 0.10°K, using the measured anisotropy-temperature relation as a secondary thermometer. The heat flow was found to depend strongly on temperature. The contacting junction apparently deteriorated during cycling to high temperatures. (M.P.G.)

36549 THE T_{62} ^{3}He TEMPERATURE SCALE. S. G. Sydoriak, T. R. Roberts, and R. H. Sherman (Los Alamos Scientific Lab., N. Mex.). p.437-8 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

The advantages of ^{3}He over ^{4}He for vapor pressure thermometry below 2.3°K are discussed. A full-range working equation scale, called the T_{62} ^{3}He temperature scale, was found to be valid for use from 0.2°K to the critical point. The T_{62} scale is compared to the 1958 International ^{4}He scale, and it is found to have a smaller standard deviation than the T_{58} scale when applied to the isotherm data on which the T_{58} scale was based. (M.P.G.)

36550 ABSOLUTE TEMPERATURES DETERMINED FROM MEASUREMENTS OF THE SPEED OF SOUND IN HELIUM GAS. G. Cataland and H. H. Plumb (National Bureau of Standards, Washington, D. C.). p.439-40 of "Low Temperature Physics." Washington, D. C., Butterworths, 1963.

The acoustical interferometer is used to measure the speed of sound in He gas. Absolute temperatures can be calculated from an equation relating the temperature to the speed of sound. The accuracy and reproducibility of this method of thermometry were studied at 2 and 20°K. It is concluded that the speed-of-sound method is competitive with other methods, such as vapor-pressure measurements, and may be an improvement over them. (M.P.G.)

Neutron Physics

36551 (GA-5373) ANGULAR DISTRIBUTION OF THERMAL NEUTRON SCATTERING FROM H_2O. J. R. Beyster and W. R. Mowry (General Atomic Div., General Dynamics Corp., San Diego, Calif.). June 1, 1964. Contract AT(04-3)-167. 17p. (CONF-452-43)

From American Physical Society, Washington, D. C., Apr. 1964.

Neutron scattering at thermal and epithermal energies from hydrogen bound in the H_2O molecule was studied to provide details for models for the vibrations, rotations, and translations of the molecules. The total neutron cross sections of H_2O at 0.001 to 10 ev and single differential cross sections from 0.01 to 4 ev were measured experimentally. (R.E.U.)

36552 (LA-3082) DELAYED NEUTRON REDUCED GROUPS BY LEAST SQUARES. Thomas E. Springer (Los Alamos Scientific Lab., N. Mex.). Dec. 19, 1961. Contract W-7405-eng-36. 19p.

A method of evaluating reduced group decay constants and abundances used in the reactor neutronic kinetic equations by a least-squares technique is described. The computed reduced parameters are presented for several different fissile species. A comparison of the neutron density time response for various reactivity steps is made between the various reduced groups for ^{235}U fast fission. (auth)

36553 (NAA-SR-9744) ESCAPE PROBABILITY APPROXIMATIONS IN LUMPED RESONANCE ABSORBERS. John M. Otter (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Aug. 1, 1964. Contract AT(11-1)-Gen-8. 17p.

An approximation to the escape probability throughout a resonance in a lumped resonance absorber is formulated. An effective average chord length, which gives a "best" fit to the exact probability, is used in the rational form of Wigner so that the equivalence between homogeneous and heterogeneous cases is maintained. Effective chord lengths are derived for the infinite mass and narrow resonance limits, both including and excluding interference between resonance and potential scattering, in planar, infinite cylindrical, and spherical geometries. The new approximation has advantages over current methods, which depend on a particular integral calculation scheme and standard integral values, because it treats each resonance individually, using only the resonance parameters and geometry. It provides a good approximation to the escape probability for any resonance from "practical" to vanishingly small lump sizes. Moreover, the shortness of calculations in the approximate escape probability mode compared to numerical solutions is not significantly altered. Resonance integrals and Doppler coefficients for ^{238}U calculated by use of various escape probability approximations are compared. (auth)

36554 (NAA-SR-9803) MEASUREMENTS OF THERMAL NEUTRON ABSORPTION CROSS SECTION AND DIFFUSION LENGTH OF GRAPHITE USING AN Sb–Be SOURCE. J. A. Dejuren, T. E. Stewart, and E. R. Specht (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Aug. 1, 1964. Contract AT(11-1)-Gen-8. 44p.

Measurements were made in the Atomics International Sodium Graphite Reactor (SGR) Critical Assembly to determine the effective thermal neutron cross section and diffusion length in AGOT graphite. The absorption cross section was determined by comparing the volume-integrated thermal neutron distribution measured in an 8 × 12-ft diameter graphite stack to that measured in a 1.5 × 1.4-m diameter water assembly using an Sb–Be neutron source and identical counting techniques. Since the measurements were made in finite assemblies, correction factors of infinite medium flux to finite medium flux vs distance from the source were obtained and applied to the measured values of $A_{th}(r)$ before equating the integrals. The diffusion length was determined from the thermal neutron distribution in regions more than 60 cm from the source. The average value obtained for the graphite absorption cross section was 4.42 ± 0.06 mb, and is in good agreement with a previously measured value of 4.38 mb (obtained from the measured diffusion length and a steady-state value of λ_{tr}). The average diffusion length measured in the direction parallel to the extrusion axis of the graphite logs was 54.77 ± 0.20 cm; and in the direction perpendicular to the extrusion axis was 55.10 ± 0.15 cm, normalized to a density of 1.60 gm/cm^3. (auth)

36555 (ORNL-3487) CALCULATION OF FISSION-SOURCE THERMAL-NEUTRON DISTRIBUTION IN WATER BY THE TRANSFUSION METHOD. D. K. Trubey (Oak Ridge National Lab., Tenn.). Aug. 1964. Contract W-7405-eng-26. 52p.

A calculational method, which combines transport theory and diffusion theory, called the "transfusion" method, was used to obtain the thermal-neutron flux from a point isotropic fission source in water. The transport theory code RENUPAK, which utilizes the moments method, was used to calculate the energy-spatial neutron distribution above 1 kev, and the multigroup diffusion code MODRIC was used to continue the calculation down to thermal energies. The resulting thermal-neutron fluxes agree very well with experimental results for distances out to 70 cm from the source, but the calculated fluxes are as much as 40% higher for greater distances. (auth)

36556 (TID-7695(p.21-4)) APPLICATIONS OF NUCLEAR EXPLOSIVES TO MEASUREMENTS OF NEUTRON

INTERACTIONS BY FOIL ACTIVATION: THE "WHEEL" METHOD. G. A. Cowan (Los Alamos Scientific Lab., N. Mex.).

The "wheel" method indirectly measures the neutrons by delayed counting of activation products in a foil detector. The advantages and disadvantages of the method relative to the direct detector method are described. The collimating slit width, wheel speed, and distance from the source defines the energy resolution for energies 100 ev and higher. Some of the results of wheel experiments on ^{235}U resonances and on resonance capture cross sections of several elements are discussed briefly. (D.L.C.)

36557 (TID-7695(p.25-30)) APPLICATIONS OF NUCLEAR EXPLOSIONS IN CROSS-SECTION MEASUREMENTS. B. C. Diven (Los Alamos Scientific Lab., N. Mex.).

The use of underground nuclear explosions as pulsed neutron sources for neutron measurements is discussed. Comparisons are made with laboratory neutron sources and the types of measurements especially suited to the explosion source are described. Before the explosion source can be exploited properly, many questions must be answered concerning production and use of beams from these sources. An outline is presented for a program of studies of detectors and neutron beam characteristics. This program will develop some of the techniques necessary to use nuclear detonations in measurements which cannot be carried out in the laboratory. (auth)

36558 (TID-20935) THERMAL NEUTRON DISTRIBUTIONS NEAR MATERIAL DISCONTINUITIES (thesis). William Thomas Fehlberg (California Inst. of Tech., Pasadena). May 27, 1964. Contract [AT(04-3)-41]. 102p.

A method is presented for the approximate calculation of the neutron flux near plane interfaces between different heavy monatomic gaseous media with absorption cross sections inversely proportional to the neutron velocity. Approximate analytic results are obtained for both the diffusion theory and transport theory models. It is found that the flux on each side of the interface can be approximated by the sum of two terms. One term has the same energy dependence that would exist in an infinite medium composed of the heavy monatomic gas that is on that side of the interface. The spatial dependence of this term is determined by diffusion theory. The other term, called a boundary layer correction, makes an appreciable contribution to the flux only near the interface. The procedure presented develops equations and boundary conditions that determine the different terms of the approximate flux. It is found that the approximate flux at the interface, for both diffusion and transport theory, is the average of the two infinite medium fluxes. (auth)

36559 (WAPD-T-1681) THE INPUT-OUTPUT PROBLEM IN TWO-DIMENSIONAL NEUTRON DIFFUSION PROGRAMS WITH LARGE MESHES. W. R. Cadwell (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). May 1964. Contract AT-11-1-GEN-14. 15p. (CONF-446-11)

From American Nuclear Society 10th Annual Meeting, Philadelphia, June 1964.

The data-flow problem in two-dimension, few-group, neutron-diffusion calculations is discussed. Some simplifying assumptions are suggested to reduce input-output times. (R.E.U.)

36560 NONSTATIONARY PROBLEMS IN THE KINETIC THEORY OF NEUTRON TRANSPORT. Ya. I. Granovskii and A. A. Kostritsa. At. Energ. (USSR), 16: 504-9(June 1964). (In Russian)

The nonstationary kinetic equation for monoenergetic neutrons is solved using the transformation of the unknown Fourier function and the source functions with calculation of the effect of initial conditions. The problem of neutron distributions from moving and from oscillating sources is considered in detail. Formulas for the dependence of the diffusion length on the source velocity are deduced, and analysis of the neutron field near it is given. (tr-auth)

36561 NEUTRON ABSORPTION IN REACTOR MATERIALS. Friedrich Wolf. Blech, No. 5, 246-9(1963). (In German)

The absorption of thermal neutrons by aluminum containing boron carbides, prepared under the trade name of Boral in the form of sheets, was studied. The physical data on this material are briefly presented, and its preparation and properties are indicated. (tr-auth)

36562 A NEW THERMAL NEUTRON FLUX DENSITY STANDARD. C. K. Hargrove and K. W. Geiger (National Research Council, Ottawa). Can. J. Phys., 42: 1593-1604 (Aug. 1964).

Six $^{241}Am-Be(\alpha,n)$ neutron sources are arranged around the central circumference of a graphite cylinder 28 cm in diameter by 26.5 cm high. This assembly is surrounded by 10 cm of polyethylene. The graphite cylinder contains an accessible central cavity, 5 cm in diameter by 5 cm high, for the calibration of thermal neutron detectors. The thermal neutron flux density in the cavity is measured by $4\pi\beta-\gamma$ coincidence counting of irradiated gold foils. A flux density below cadmium cutoff of $n_{th}v_0 = 8.70 \times 10^3$ cm^{-2} sec^{-1} (±1.5%) was found. The uniformity is shown to be constant within the cavity to better than ±0.5% over a cylindrical volume 5 cm in diameter by 2 cm high. (auth)

36563 AN EASILY REGENERABLE ANTIMONY-BERYLLIUM RADIATION SOURCE. Janos Torko (National Commission for Atomic Energy, Budapest). Magy. Kem. Lapja, 19: 299(June 1964).

An antimony-beryllium neutron source, which is described, comprises a 20 by 25 cm beryllium cylinder and a 5 by 25 cm antimony rod within the former. The assembly is encased in an aluminum container and is locked with a bayonet clamp. Over-all outside diameter of the source is 22 by 45 cm. This rapid-acting clamp enables the separate handling of the active and inactive portions of the source, its convenient transportation, and its assembly on location. No lead shielding is required during shipping. The antimony rod can be relatively easily removed from the assembled source for regeneration. No manipulators are required in any of these operations. (OTS)

36564 MEASUREMENT OF THE NEUTRON SPECTRUM FROM RADIUM D-BERYLLIUM WITH NUCLEAR EMULSIONS. P. Amadesi, E. Cambrisi, and A. Cavallini (CNEN, Bologna). Nuovo Cimento (10), 33: 211-20(July 1, 1964).

The neutron spectrum from a RaD-Be source was measured with the nuclear emulsion technique. This technique allows spectrum measurements of fast neutrons with a good energy resolution and can be used also for wide and uncollimated sources, such as in the case of in core neutron fluxes. The plate chosen is a 200 μm thick Ilford K2, on a glass mount. The method is based on the determination of the track lengths of recoil protons from elastic scattering of neutrons on hydrogen nuclei of the emulsion. The differential spectrum obtained has 0.2-Mev channel width. Statistical errors are not larger than 7% for 85% of the channels taken into account in this case. (auth)

36565 ACTIVATION ANALYSIS WITH FAST NEUTRONS USING A MOBILE NEUTRON GENERATOR. E. Merz (Kernforschungsanlage, Julich, Ger.). p.211-16 of "Atomstrahlung in Medizin und Technik." Munich, Verlag Karl Thiemig KG, 1964. (In German)

The design of a 150-kv Cockcroft-Walton neutron generator is briefly reviewed. The principles and advantages of activation analysis are indicated. The utility and serviceability of the instrument is illustrated by reporting its use in the detection of O, N, F, Si, Cr, Fe, and Cu. (J.S.R.)

Nuclear Properties and Reactions

Refer also to abstracts 35588, 36262, and 36303.

36566 (BNL-7191) COMPUTATION OF THE COEFFICIENTS MULTIPLYING THE INDEPENDENT TWO-PARTICLE RADIAL MATRIX ELEMENTS OF A NUCLEAR HAMILTONIAN. Nazakat Ullah (Brookhaven National Lab., Upton, N. Y.). [July 3, 1963]. Contract [AT(30-2)-Gen-16]. 15p.

The two-particle matrix element of a nuclear hamiltonian in the basis of jj coupled functions is expressed as a product of certain coefficients and the independent two-particle radial matrix elements. A FORTRAN program is described, which calculates these coefficients for scalar and tensor potentials. The scalar potentials are taken to be spin independent, spin singlet, and spin triplet. A sample numerical output and a IBM 7090 FORTRAN listing is also given. (auth)

36567 (CONF-446-10) NEPTUNIUM-237 NEUTRON CROSS SECTIONS. D. T. Goldman (Knolls Atomic Power Lab., Schenectady, N. Y.). [1964]. Contract W-31-109-eng-52. 15p.

From American Nuclear Society 10th Annual Meeting, Philadelphia, June 1964.

Available information and that to be calculated or interpolated on neutron cross sections for two-neutron-capture-produced ^{237}Np from ^{235}U are reviewed. (R.E.U.)

36568 (CRRP-1186) THE TOTAL NEUTRON CROSS SECTION OF Pu-241 BELOW 1000 ev. D. S. Craig and C. H. Westcott (Atomic Energy of Canada Ltd., Chalk River, Ont.). Mar. 1964. 64p. (AECL-1948)

Measurements were made of the total neutron cross section of ^{241}Pu for energies of 0.025 to 0.75 ev and 13.8 to 1000 ev using both a specimen of PuO_2 powder and one of Pu-Al alloy. The ^{241}Pu content of the plutonium was 80%. The specimen thickness was known to be 2%. The measurements were made with the BNL-AECL chopper at CRNL using resolutions up to 0.02 μsec/m. The experimental results are given in tabular and graphical forms together with recommended values obtained after correcting for the other nuclei present. Resonance parameters are given for the region from 12 to 32 ev. When these parameters are used with the single-level Breit-Wigner formula, a reasonable fit to the data is obtained. (auth)

36569 (INSJ-66) MEMORANDUM ON MIXED ANGULAR CORRELATIONS. Mitsuo Sakai and Toshimitsu Yamazaki (Tokyo Univ. Inst. for Nuclear Study). Jan. 25, 1964. 7p.

The analysis of experimental angular correlation data in nuclear structure studies is discussed with emphasis on the sign of the multipole mixing ratio for gamma-gamma and conversion electron-gamma correlations. Comments are made on the penetration effect on M1 transitions. (R.E.U.)

36570 (INSJ-73) DEUTERONS FROM 55-Mev PROTON BOMBARDMENT OF ^{52}Cr AND ^{60}Ni. H. Ejiri, H. Koike, N. Ishizaki, K. Matsuda, Y. Nakajima, I. Nonaka, Y. Saji, E. Tanaka, and K. Yagi (Tokyo Univ. Inst. for Nuclear Study). May 26, 1964. 7p.

The reactions $^{52}Cr(p,d)^{51}Cr$ and $^{60}Ni(p,d)^{59}Ni$ were investigated using 55-Mev protons from a synchrotron. Isotopically enriched ^{60}Ni of 10.24 mg cm^{-2} and natural ^{52}Cr of 9.59 mg cm^{-2} were used as the targets. Deuterons from the (p,d) reaction were analyzed by a broad range magnetic spectrometer. Momentum spectra of deuterons are shown, angular distributions were measured for a number of deuteron groups that lead to excited states in ^{51}Cr and ^{59}Ni, and numerical values of differential cross sections are listed. (auth)

36571 (INSJ-74) NUMERICAL DIFFERENTIAL CROSS SECTIONS OF ELASTIC AND INELASTIC SCATTERING OF PROTONS FROM Ni^{60} AT 55 Mev. Masahiro Koike, Kazuhisa Matsuda, Yutaka Nakajima, Itaru Nonaka, Yoshio Saji, Eiji Tanaka, Kohsuke Yagi, Hiroyasu Ejiri, and Yoshihide Ishizaki (Tokyo Univ. Inst. for Nuclear Study). June 1964. 10p.

Numerical differential cross sections for elastic and inelastic scattering of protons from ^{60}Ni are presented. The target used was of enriched ^{60}Ni, and its thickness was 10.24 mg/cm^2. The energy of the incident protons accelerated with the INS synchrotron was 55.00 ± 0.25 Mev. Momentum analysis of the scattered protons was performed with a magnetic analyzer system, which was operated with energy resolution of about 1%. A forty channel proportional-scintillation counter telescope was used for detection of the analyzed protons. Seven proton groups corresponding to the excited states of ^{60}Ni were observed in the momentum spectra. Errors of the cross sections include not only the statistical ones but also those due to background subtraction. The obtained Q-values of the inelastic scattering were −1.3, −2.6, −3.4, −4.2, −5.1, −6.2, and −6.8 Mev. The errors of the Q-values were estimated to be about 200 kev. (auth)

36572 (INSJ-75) NUMERICAL DIFFERENTIAL CROSS SECTIONS OF THE REACTION $^{11}B(p,n)^{11}C$ IN THE ENERGY RANGE FROM 7.6 Mev TO 11.03 Mev. PART I. Yoshio Saji, Yoshihide Ishizaki, Hisashi Yamaguchi, Yoshihiro Nakano, Nobuhiro Yamamuro, Masatoshi Odera, Kazunori Yuasa, Bunsaburo Saheki, Takashi Tsuchimoto, and Naonori Yoshimura (Tokyo Univ. Inst. for Nuclear Study). June 1964. 5p.

Numerical differential cross sections for the reaction $^{11}B(p,n)^{11}C$ are shown. The energies of the incident protons were varied from 7.6 to 11.03 Mev in the laboratory system. A target used in the present work was made by sedimentation and deposited on to a thin nickel foil and the thickness of a target material was 4.0 mg/cm^2. Neutrons emitted from a target were measured by a time-of-flight method. Flight paths of neutrons were from 2 to 4 meters. A plastic scintillator of 45 mm in diameter and 50 mm in thickness was used as a detector. In the tables, the energies of the incident proton E_p were presented in laboratory system, but angles and differential cross sections were presented in a center-of-mass-system. (auth)

36573 (INSJ-76) NUMERICAL DIFFERENTIAL CROSS SECTIONS OF THE REACTIONS $^{11}B(p,n)^{11}C$ IN THE ENERGY RANGE FROM 7.6 Mev TO 11.03 Mev. PART II. Yoshihide Ishizaki, Hisashi Yamaguchi, Yoshio

Saji, Kazunori Yuasa, Bunsaburo Saheki, Takashi Tsuchimoto, Naonori Yoshimura, Nobuhiro Yamamuro, Masatoshi Odera, and Yoshihiro Nakano (Tokyo Univ. Inst. for Nuclear Study). June 22, 1964. 11p.

Numerical differential cross sections of the reaction $^{11}B(p,n)^{11}C$ corresponding to the ground state of ^{11}C were reported previously (INSJ-75). Now those corresponding to the same excited states are shown. Those excited states are at 1.99, 4.26, and 4.75 Mev. Integrated cross sections of these reactions are listed. (auth)

36574 (KFKI-1491-F) SHELL MODEL STUDY OF Cl^{36} AND Ar^{36} NUCLEI. I. Lovas and J. Réval (Magyar Tudományos Akademia Központi Fizikai Kutató Intézete, Budapest). 1963. 10p.

By means of the shell model, the properties and eigenvectors of the low-lying levels in ^{36}Cl and ^{36}Ar were determined, taking into account configuration mixing. The Rosenfeld type exchange force has led to a full contradiction between calculated and experimental data, but the Serber force has given rather good agreement. The magnetic moment of ground-state ^{36}Cl was calculated using the eigenvectors obtained from the energy matrix diagonalization. Making use of the available experimental data and the results of calculations, a consistent level scheme of ^{36}Cl was constructed. (auth)

36575 (NP-14084) IZUCHENIE GIROMAGNITNYKH OTNOSHENII YADER V VOZBUZHDENNOM SOSTOYANII. (Study of the Gyromagnetic Relation of Nuclei in an Excited State (thesis)). V. A. Klyucharev (Khar'kovskiĭ Gosudarstvennyĭ Universitet imeni A. M. Gor'kogo and Akademiya Nauk Ukr. S.S.R. Fiziko-Tekhnicheskii Institut, Karkov). 1963. 172p.

Principles are given for methods of directly measuring gyromagnetic ratios of excited state nuclei. Coulomb excitations, γ-γ correlations, and limitations of the direct methods are discussed. A review is given of data on gyromagnetic ratios using ^{181}Ta, ^{182}W, ^{147}Pm, ^{153}Eu, and ^{199}Hg. The data were correlated with calculations carried out using the collective and superfluidity models. An analysis is made of the perspectives and means for further development of the direct methods. Descriptions are given of the measuring devices (electromagnet, goniometer, γ detectors, electronic recording devices, and γ sources) and of the data processing. The measurement of magnetic moments in excited nuclei by γ resonance scattering and the effects of atomic fields on γ-γ angular correlations are also considered. 81 references. (R.V.J.)

36576 (NP-14167) INFLUENCE DE LA DISTORSION COULOMBIENNE SUR LA PRODUCTION DE PAIRES D'ELECTRONS PAR UN RAYONNEMENT γ PRES DU SEUIL (theses). (Influence of Coulomb Distortion on Electron Pair Production by γ Radiation Near the Threshold (thesis)). Jean Huck (Lyon. Université). June 18, 1964. 150p.

The total effective cross section for electron pair production by a gamma ray in a nuclear field was calculated by Born approximation and a partial-wave method. The cross section for pair production in iodine was measured using several isotopic gamma sources. From consideration of the experimental and theoretical results, together with absolute measurements of the cross section in lead, a relation for the cross section in terms of the gamma energy and Z was obtained. (D.C.W.)

36577 (NP-14202) THE METHOD OF INTERACTING QUASI-PARTICLES IN THE NUCLEAR THEORY. A. B. Migdal (U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoĭ Energii). 1964. 35p.

An attempt is made to apply consistently the methods of calculation of strong-interaction Fermi systems to the nucleus. It is shown that the nucleus can be regarded as a system of interacting quasiparticles, between which it is sufficient to take into account pair collisions alone. Multiple collisions of particles are taken into account accurately, but lead to the renormalization of the quasiparticle interaction constants. These constants are identical for all nuclei except the lightest, and all types of transitions near the Fermi surface. (auth)

36578 (ORNL-3610) THE NUCLEON TRANSPORT CODE, NTC. W. E. Kinney (Oak Ridge National Lab., Tenn.). Aug. 1964. Contract W-7405-eng-26. 100p.

Detailed information concerning the interactions of high-energy (about 400-Mev) nucleons with matter is of particular interest in the design of radiation shields for space vehicles and high-energy particle accelerators. The Monte Carlo method was applied to the calculation of such interactions in the construction of the Nucleon Transport Code (NTC), a linked series of newly written codes for treatment of high-energy transport and previously written codes for the treatment of neutrons of energies below 50 Mev. NTC, written for the IBM-7090 computer, calculates the transport of nucleons having initial energies as high as 400 Mev through complex arbitrary configurations containing a maximum of four media, each of which may be composed of up to ten isotopes. Cascade processes and particle evaporation from excited nuclei are taken into account. The end result of NTC is one or more magnetic tapes containing the detailed records of all quantities pertinent to the transport of the nucleon. These tapes can be independently analyzed by the individual user of NTC to produce desired solutions to specific problems. Appendices include typical analysis routines; a list of tape assignments; a users' manual for the low-energy portion of the code and for the geometry routine; and a full-scale demonstration problem, complete in all details, which can be used to verify satisfactory performance by all parts of the code group. (auth)

36579 (PAN-332) COULOMB EXCITATION OF THE RHODIUM NUCLEUS. S. Kopta, H. Niewodniczanski, and B. Pudlowska (Polish Academy of Science. Inst. of Nuclear Physics, Krakow). Apr. 1964. 19p.

Coulomb excitation of ^{103}Rh was studied using 5.13-Mev α particles and protons at 0.90 to 1.28 Mev accelerated in a 48-cm cyclotron. The reduced transition probabilities were found to be (0.42 ± 0.08) and (0.18 ± 0.04) e^2b^2 for the (360 ± 5) and (298 ± 5) kev levels, respectively. The cascade-to-crossover ratio was determined as 0.20 ± 0.02. The electric octupole excitation of the 40-kev isomeric state was not observed. (auth)

36580 (UCRL-7506) FRACTIONAL PARENTAGE COEFFICIENTS FOR THREE PARTICLES IN THE j = 7/2 SHELL. Ervin H. Schwarcz (California. Univ., Livermore. Lawrence Radiation Lab.). Sept. 18, 1963. Contract W-7405-eng-48. 6p.

The fractional parentage coefficients for all isospins and all seniorities are given for three nucleons in the $j = 7/2$ shell. (R.E.U.)

36581 (UCRL-11379) CORIOLIS INTERACTIONS IN ODD-ODD NUCLEI: Am^{242m} ALPHA DECAY. F. Asaro, M. C. Michel, S. G. Thompson, and I. Perlman (California. Univ., Berkeley. Lawrence Radiation Lab.). June 1964. Contract W-7405-eng-48. 7p. (CONF-502-17)

From International Congress of Nuclear Physics, Paris, July 1964.

Nuclear spectroscopic studies of the alpha decay of ^{242m}Am have led to the identification of new excited states and gamma transitions in ^{238}Np. All of the observed levels compare favorably with the predictions from odd-mass nuclei. This is especially true for the observed moments of inertia. A number of the gamma intensities were interpreted in terms of Coriolis interactions between states having common neutron and proton quasiparticles and differing in K by 1. Most of the other gamma-ray intensities could be related to transitions in odd-mass nuclides. For some transitions it was necessary to postulate explanations involving multiple-order Coriolis effects and residual neutron-proton interactions. (auth)

36582 DISTRIBUTION OF THE RATIO OF CAPTURE TO FISSION CROSS SECTION FOR ^{239}Pu ACCORDING TO HEIGHT IN THE BR-5 REACTOR. V. I. Ivanov, N. N. Krot, and G. N. Smirenkin. At. Energ. (USSR), 16: 497-500(June 1964). (In Russian)

A study was made of the distribution of the capture to fission ratio σ_γ/σ_f for ^{239}Pu according to height in the BR-5. The distribution of capture reactions was measured by determining ^{240}Pu as a function of the spontaneous fission rate in plutonium samples irradiated by an integral flux of 10^{21} to 10^{22} n/cm^2. Almost isotopically pure ^{239}Pu (^{240}Pu content $\approx 5 \times 10^{-3}$%) was used as the initial material. Values of β as a function of increasing distance from the reactor center increased from 0.1 to 0.8. Data corresponding to an equilibrium neutron spectrum in the active zone and in an external region of the reflector agree with results of measurements of σ_γ and σ_f for monoenergetic neutrons. (tr-auth)

36583 ANGULAR DISTRIBUTIONS OF FISSION PRODUCTS AFTER ^{235}U AND ^{239}Pu FISSION BY 0.08 TO 1.25 Mev NEUTRONS. V. G. Nesterov, Yu. A. Blyumkina, L. A. Kamaeva, and G. N. Smirenkin. At. Energ. (USSR), 16: 519-21(June 1964). (In Russian)

The total angular distribution of fragments from the fission of ^{235}U and ^{239}Pu by 0.08 to 1.25 Mev neutrons was measured, using six ionization chambers at 13 to 81° around the fissioning source. The measured energy dependence of the angular distributions is presented and discussed in comparison with other experimental and theoretical results. (M.J.T.)

36584 AVERAGE KINETIC ENERGY OF FISSION PRODUCTS ABOVE THE (n,nf) THRESHOLD. V. N. Okolovich and G. N. Smirenkin. At. Energ. (USSR), 16: 521-3(June 1964). (In Russian)

The dependence of the average kinetic energy of fission fragments, $\overline{E}_K$, on the excitation energy of the fissioning nucleus, E_x, was studied for the fission of ^{233}U by 15- and 20-Mev neutrons, ^{235}U by 20-Mev neutrons, and ^{238}U and ^{239}Pu by 15-Mev neutrons, to fill gaps in previous experimental results. An ionization chamber with a grid was used for the measurements. The Fowler hypothesis, that $\overline{E}_K$ is independent of $\overline{E}_x$, is tested. Results of measurements of $\Delta\overline{E}_K$, the deviation of $\overline{E}_x$ at given neutron energies from the nearly constant $\overline{E}_K$ at thermal energies, are presented for the nuclei studied. Data from the present and previous works on the dependence of $\Delta\overline{E}_K$ during fission of the compound nuclei ^{234}U and ^{236}U on E_x are correlated for E_x from 0 to 27 Mev. The decrease in $\overline{E}_K$ in the studied range of E_x is a regular effect, not depending on the type of nuclear target. An attempt is made to explain the decrease of $\overline{E}_K$ with increasing E_x by the change of distribution of fragment mass and by the dependence of the fragment kinetic energy on their mass ratio. (M.J.T.)

36585 CROSS SECTIONS OF NEUTRON REACTIONS WITH ^{149}Sm AND ^{115}In. R. B. Begzhanov, D. A. Gladyshev, S. V. Starodubtsev, and T. Khaidarov. At. Energ. (USSR), 16: 523-4(June 1964). (In Russian)

Total effective cross sections for neutron reactions with ^{115}In and ^{149}Sm at 0.7 to 14 ev and 0.4 to 8 ev, respectively, were measured, using a neutron spectrometer. Resonance parameters for the reactions are presented. (M.J.T.)

36586 A PRECISE MEASUREMENT OF THE C^{11} PRODUCTION CROSS SECTION FOR 98-Mev PROTONS ON CARBON. T. M. Kavanagh, J. K. P. Lee, and W. T. Link (McGill Univ., Montreal). Can. J. Phys., 42: 1429-36(Aug. 1964).

A precise measurement of the cross section for the production of ^{11}C positron activity by the proton bombardment of natural carbon is described. Extensive subsidiary experiments were performed to evaluate the errors in the factors entering the measurement. The cross section is $(63.3 \pm 0.3) \times 10^{-27}$ cm^2 per atom of natural carbon for protons of range 9515 mg/cm^2 of aluminum (indicated energy 98.1 Mev). (auth)

36587 ANNIHILATION OF POSITRONS IN LIQUID HELIUM AND THE POSITRON-HELIUM BOUND STATE. H. C. Khare, P. R. Wallace, G. G. Bach, and A. Chodos (McGill Univ., Montreal). Can. J. Phys., 42: 1522-28 (Aug. 1964).

It is shown that it is possible for a positron to form a bound state with a helium atom, with a binding energy of about 0.55 electron volt. The lifetime of positrons in liquid helium is substantially longer than the predicted lifetime for annihilation from this state, indicating that capture into such a state takes a time considerably longer than the annihilation lifetime. On the other hand, the observed lifetime implies an electron density at the positron larger than the mean electron density in the material, consistent with the expected attraction of the positron toward the helium atom. (auth)

36588 RANGES OF HEAVY IONS IN AMORPHOUS OXIDES. B. Domeij, F. Brown, J. A. Davies, and M. McCargo (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Phys., 42: 1624-34(Aug. 1964).

The range distributions of ^{24}Na, ^{41}Ar, ^{85}Kr, and ^{125}Xe ions in amorphous Al_2O_3 and WO_3 were measured in the energy interval 0.5 to 160 kev. The experimental technique consisted of measuring the transmission through oxide layers formed anodically on metal foils. The penetrating tail of distributions measured in crystalline targets is found to be absent in amorphous targets. Comparison with the calculations of Lindhard et al., who assume a random distribution of the target atoms, shows good agreement between theory and experiment. (auth)

36589 THE NUCLEAR g FACTOR OF THE FIRST EXCITED STATE OF Pt^{192}. J. A. Cameron. Can. J. Phys., 42: 1680-82(Aug. 1964).

The nuclear gyromagnetic ratio of the first excited state of ^{192}Pt was measured by observing the precession of γ-γ directional correlations in the internal field in iron. The obtained value $g = 0.27 \pm 0.07$ is somewhat smaller than expected for a vibrational level. (F.S.A.)

36590 NUCLEAR LEVELS OF RADIUM 223 (ACTINIUM X) OBSERVED STARTING WITH THORIUM 227 (RADIOACTINIUM). Geneviève Bastin-Schoffier, Chin Fan Leang, and Robert J. Walen (Centre de Spectrometrie Nucleaire et

de Spectrometrie de Masse, Orsay, France). Compt. Rend., 258: 6397-8(June 29, 1964). (In French)

The alpha spectrum of radioactinium, under re-examination, shows a great complexity with 30 new rays in addition to the 15 rays already known. The energies and other properties of the alpha emissions are tabulated. (J.S.R.)

36591 THE NON EXISTENCE OF THE ^{92m}Nb ISOMER. H. E. Bosch (Laboratorio de Radiaciones, Dinfia, Buenos Aires), S. M. Abecasis, E. Ansaldo, A. Jech, and M. Mariscotti. J. Inorg. Nucl. Chem., 26: 1337-9(Aug. 1964).

A search for an isomer of ^{92}Nb from the ^{93}Nb(d,p2n) reaction was made. No evidence of either the already reported 13-hr activity or of a 2.35-Mev γ ray was found. The possibility of the existence of the 2.35-Mev γ ray as well as of the 13-hr activity in other chemically separated fractions formed in the same nuclear reaction was also ruled out. (auth)

36592 CONCERNING ISOMERS OF ^{208}At, ^{206}At, AND ^{204}At. P. E. Thoresen, F. Asaro, and I. Perlman (Univ. of California, Berkeley). J. Inorg. Nucl. Chem., 26: 1341-7(Aug. 1964). (UCRL-11148)

The half lives of isomers of ^{208}At, ^{206}At, and ^{204}At produced in alpha particle bombardments of bismuth were investigated by periodically separating and analyzing the polonium daughters. Only the shorter-lived isomer of each astatine isotope was observed; 9-min ^{204}At, 33-min ^{206}At, and 1.6-hr ^{208}At. It was found that the previously assigned longer-lived isomers of ^{208}At, ^{206}At, and probably ^{204}At were illusions due to chemical effects. (auth)

36593 NEW RADIOISOTOPES OF NIOBIUM AND MOLYBDENUM. I. ^{88}Nb. F. D. S. Butement and S. M. Qaim (Univ. of Liverpool). J. Inorg. Nucl. Chem., 26: 1481-9(Sept. 1964).

A new radioisotope of half life 21 min was observed in the neutron deficient isotopes of niobium produced by (p,pxn) and (p,2pxn) reactions with 340 Mev protons. The activity is assigned to ^{88}Nb on the basis of its genetic relationship to ^{88}Zr. Half lives of the known isotopes ^{89}Nb, ^{89m}Nb and ^{90}Nb were determined as 2.0 hr, 42 min, and 14.7 hr respectively. Positron and γ spectra of these isotopes were studied. ^{88}Nb emits 3.2 Mev positrons and 0.20, 0.72, 0.97, and 1.42 Mev γ rays. (auth)

36594 NEW RADIOISOTOPES OF NIOBIUM AND MOLYBDENUM. II. ^{88}Mo AND ^{89}Mo. F. D. S. Butement and S. M. Qaim (Univ. of Liverpool). J. Inorg. Nucl. Chem., 26: 1491-1501(Sept. 1964).

Two new activities were found in the neutron deficient isotopes of molybdenum produced by (p,pxn) reactions on molybdenum. The half lives were 27.3 ± 1.4 and 7.1 min. These activities were assigned to ^{88}Mo and ^{89}Mo, respectively on the basis of their genetic relationship with niobium and zirconium isotopes. ^{88}Mo was also produced by a (p,xn) reaction on niobium. Positron and γ spectra of these and a few other neutron deficient isotopes of molybdenum were studied. ^{89}Mo emits 2.5 Mev positrons and a 2.69 Mev γ ray. ^{89}Mo emits positron groups of energies 4.05 and 4.95 Mev. (auth)

36595 RADIO-ISOTOPE SEPARATION APPLIED TO THE STUDY OF NUCLEAR REACTIONS. G. Andersson and G. Rudstam (CERN, Geneva). Nucl. Instr. Methods, 29: 93-100(Sept. 1964).

Various implications of using an electromagnetic isotope separator in preparing samples for reaction yield studies are discussed. Particular attention is given to the possibility of mass discriminating effects on the relative amounts of collected isotopes. It is shown theoretically that, in unfavorable cases, the error introduced in yield ratios may be large enough to necessitate experimental calibration in order to reach the accuracy aimed at. The results of some test runs agree with these considerations. (auth)

36596 THE ^{19}F(p,p′) REACTION AT 140 Mev. D. Newton, A. B. Clegg, and G. L. Salmon (Nuclear Physics Lab., Oxford). Nucl. Phys., 55: 353-63(July 1964).

Measurements are presented of the states excited in the inelastic scattering of 140-Mev protons from the ^{19}F nucleus. It is shown that they can be interpreted as a strong electric quadrupole transition exciting the J = $^5/_2$ state of the ground state rotational band, two strong electric octupole transitions exciting J = $^5/_2$ and $^7/_2$ states of the negative parity rotational band and a strong E4 transition exciting the J = $^9/_2$ state of the ground state rotational band. This interpretation adds considerably to the information available about the rotational bands of ^{19}F. (auth)

36597 α-PARTICLES FROM (n,α) REACTIONS IN Mo ISOTOPES AT $E_n \approx 15$ Mev. P. Cuzzocrea (Università, Naples and Istituto Nazionale Fisica Nucleare, Naples), S. Notarrigo, and A. Rubbino. Nucl. Phys., 55: 364-74 (July 1964).

Measurements with a solid-state detector were taken of α-particle spectra from ^{92}Mo, ^{94}Mo, ^{95}Mo, ^{96}Mo, ^{98}Mo, and ^{100}Mo isotopes irradiated with ≈15-Mev neutrons. The angular distribution of the ^{92}Mo(n,α_0)^{89}Zr reaction, was measured using the particular method of analyzing the yield of the α-particles as a function of the distance between target and detector. Results were analyzed in terms of direct interactions theory. A fairly good agreement was found between theoretical calculations and experimental data either for spectroscopic factors of ground-state transitions as well as for angular distributions of pick-up processes. (auth)

36598 ABSOLUTE CROSS-SECTIONS AND EXCITATION FUNCTIONS FOR α-PARTICLE-INDUCED REACTIONS ON BROMINE BETWEEN 10 AND 24 Mev. L. J. Gilly, P. Henriet, Preciosa Alves, and P. C. Capron (Université, Louvain, Belg.). Nucl. Phys., 55: 375-85(July 1964).

Absolute cross sections and excitation functions for α induced reactions were measured, from 10 to 24 Mev, by activation and stacked foil techniques. The following reactions were seen: ^{79}Br(α,n)^{82}Rb 6.3 h, ^{79}Br(α,αn)^{78}Br 6.4 min, ^{79}Br(α,2n)^{81}Rb 31.5 min and 4.7 h, ^{81}Br(α,αn)^{80}Br 18 min and 4.4 h, ^{81}Br(α,n)^{84}Rb 23 min. The experimental results were compared with theoretical predictions based on the optical model and statistical analysis. It seems that the magnitude of the cross sections is best predicted by optical model calculations. The shape of the excitation function for compound nucleus formation agrees best with the continuum theory, but the shapes of the individual cross sections are not in agreement with evaporation calculations, and some of the excitation functions are very peaked. Isomeric ratios seem to indicate that the (α,αn) reactions proceed through direct interaction and that there might be some admixture of compound nucleus and direct reaction on the high energy side of (α,2n) reactions. (auth)

36599 ELASTIC AND INELASTIC SCATTERING OF 12.8-Mev DEUTERONS BY ^{27}Al AND ^{28}Si NUCLEI. H. Niewodniczanski (Inst. of Nuclear Physics, Krakow), J. Nurzyński, A. Strzałkowski, J. Wilczyński, J. R. Rook, and P. E. Hodgson. Nucl. Phys., 55: 386-96(July 1964).

The angular distributions of elastic and inelastic scattering of 12.8-Mev deuterons to the first few excited levels of ^{27}Al and ^{28}Si nuclei were measured. The elastic and first inelastic ($0^+ \rightarrow 2^+$) excitation in silicon are analyzed by the strong coupling optical model and applied to the corresponding excitation in aluminum using the excited core model. (auth)

36600 DECAY OF Y^{88} TO THE 3.22 AND 3.52 Mev LEVELS OF Sr^{88}. S. Shastry and R. Bhattacharyya (Saha Inst. of Nuclear Physics, Calcutta). Nucl. Phys., 55: 397-400(July 1964).

Decay of ^{88}Y was studied in a 10 cm in diam. and 10 cm thick NaI(Tl) phosphor. Two levels of ^{88}Sr at 3.22 and 3.52 Mev were identified in the capture decay of ^{88}Y. (auth)

36601 NEW LEVELS IN Dy^{161}. L. Funke, H. Graber, K.-H. Kaun, H. Sodan, and L. Werner (Zentralinstitut fur Kernforschung, Rossendorf, Ger.). Nucl. Phys., 55: 401-9(July 1964). (In German)

The beta and gamma spectra and the $\gamma\gamma$- and $\beta\gamma$-coincidence spectra in the decay of ^{161}Tb (7.2 d) were measured, and new gamma transitions with energies of 290 ± 5, 340 ± 10, 410 ± 7, 470 ± 7, and 545 ± 7 kev were found. Their intensities per decay are 0.1, 0.02, 0.01, 0.02, and 0.04 per cent, respectively. The gamma lines fall off with a half life time of 7.3 ± 0.6 d. A beta transition in coincidence with the 290-kev gamma line is reported, the maximum energy being 220 ± 10 kev. A proposal for the decay scheme contains in addition to the known levels with the characteristics 25.62 kev ($^5/_2^-$), 43.77 kev ($^7/_2^+$), 74.50 kev ($^3/_2^-$), 102.98 kev ($^7/_2^-$), and 131.65 kev ($^5/_2^-$), three new levels at energies of 365, 415, and 545 kev, which are interpreted as one particle excitations of the 95th neutron $^1/_2$, $^1/_2^-$[521]; $^3/_2$, $^1/_2^-$[521]; and $^3/_2$, $^3/_2^+$[651]. (auth)

36602 MODIFIED STATISTICAL MODEL FOR FINITE NUCLEI. Witlof Brunner (Institut fllr Spezielle Probleme der Theoretischen Physik, Deutsche Akademie der Wissenschaften, Berlin). Nucl. Phys., 55: 410-32(July 1964). (In German)

Using the Brueckner-Gammel-Weitzner theory of finite nuclei, including the assumption that the effective two-nucleon interaction is given by the infinite-medium results, a modified statistical model for the calculation of the integral nuclear parameters is developed. It is shown, that in the present model the calculated rms radius and the central density, for finite nuclei are in fair agreement with the experimental data. The surface thickness is dependent on the assumption about k_F in the exchange term. For $k_F = k_F(\overline{\rho})$ it increases with A and, for heavy nuclei, is about 1.5 fm too large. The binding energy, however, is about 4 Mev too small, partially because of the above assumption on the effective two-nucleon interaction, including the neglect of cluster effects. The results are discussed and compared to the results obtained by self-consistent solutions of the modified Hartree-Fock equations. (auth)

36603 STUDY OF THE REACTION ^{6}Li + ^{6}Li BETWEEN 2 AND 4.4 Mev. D. Manesse, M. Coste, C. Lemeille, L. Marquez, and N. Saunier (CEN, Saclay, France). Nucl. Phys., 55: 433-42(July 1964). (In French)

The reaction ^{6}Li + ^{6}Li was studied between 2 and 4.4 Mev. The results are analyzed in terms of three possible reaction mechanisms: stripping, and activated complex and compound nucleus. (auth)

36604 DEUTERON SCATTERING IN NUCLEAR MATTER. A. G. Sitenko and E. Ismatov (Inst. of Physics, Kiev). Nucl. Phys., 55: 443-8(July 1964).

The scattering of deuterons by density fluctuations in nuclear matter is considered. The relative contribution of elastic scattering and the process of disintegration to the total cross section for the deuteron-nuclear matter interaction are determined. The ratio of the imaginary part of the deuteron optical potential to that of the nucleon optical potential is calculated. (auth)

36605 AN OCCUPATION NUMBER REPRESENTATION FOR SHELL-MODEL REACTION CALCULATIONS. Charles D. Goodman (Oak Ridge National Lab., Tenn.). Nucl. Phys., 55: 449-62(July 1964).

A computational technique is described for handling certain problems involving many-fermion wave functions. The technique uses occupation number diagrams which give a pictorial representation of the system. Because these diagrams are in essence binary numbers, the technique lends itself to computations on automatic digital computers. The conditions imposed by macroscopic quantum numbers are introduced by way of the fundamental properties of the quantum mechanical operators; no explicit use of derived theorems is involved; and no particular angular momentum coupling scheme is essential to the problem. The particle aspects of the problem rather than the angular momentum coupling aspects are emphasized by the nature of the diagrams. The method is applied to the calculation of pickup reaction spectroscopic factors in the jj-coupling nuclear shell model. (auth)

36606 THE POLARIZATION OF ELASTICALLY SCATTERED PROTONS ON C^{12} AT 4.5 Mev ENERGY. I. Boca, M. Cenja, E. Iliescu, and N. Martalogu (Inst. for Atomic Physics, Bucharest). Nucl. Phys., 55: 471-6(July 1964).

The angular distribution of the polarization of elastically scattered protons from ^{12}C between angles of 50-128° in the laboratory system was studied. The calculus of the polarization was made using the phases given by Reich et al. A good agreement of the experimental data with the theoretical predictions is obtained by a suitable variation of the phases. (auth)

36607 THE LOW-LYING LEVELS OF ^{8}Be. B. S. Madsen and M. Vedelsby (Universitet, Copenhagen). Nucl. Phys., 55: 477-80(July 1964).

A search was made for the 3.77- and the 6.95-Mev α particles reported by Cavallaro et al. from proton reactions on ^{7}Li. A 3.77-Mev α group of the intensity stated was observed, but could be unambiguously assigned to the reaction $^{18}O(p,\alpha)^{15}N$. The 6.95-Mev group was not present in the spectra; an upper limit of 15% of the earlier reported intensity was established. Thus, no evidence was obtained for the existence of the levels in ^{8}Be at 7.56, 13.91, and 18.0 Mev found by Cavallaro et al. (auth)

36608 HARTREE-FOCK FIELDS AND IONIZATION POTENTIAL FOR O^{15} FOR A GENERAL TWO-NUCLEON POTENTIAL. H. A. Ali and G. E. Tauber (Western Reserve Univ., Cleveland). Nucl. Phys., 55: 481-8(July 1964).

Starting with an assumed nucleon-nucleon potential $V(r_1 - r_2)$ and the independent particle model, the effective Hartree-Fock fields for the 1s and 1p nucleons in the ^{15}O nucleus were calculated. The $V(r_1 - r_2)$ is assumed to contain tensor and spin-orbit forces, in addition to the central and Coulomb forces, as well a repulsive hard core. In order to take the hard core into account the individual particle wave functions are modified to include a correlation function which is shown to give rise to an additional effective two-body potential. The wave functions are assumed to be combinations of determinantal functions. The

calculated effective fields in ^{15}O are graphed against the coordinate r_1. Binding energies of the last nucleons in ^{15}O are also calculated, and the results compared with earlier work along similar lines, but in which all forces except the central and Coulomb forces were neglected. This comparison shows that there is some improvement in the binding energies. (auth)

36609 TWO-NUCLEON STRIPPING REACTIONS ON DEFORMED NUCLEI. M. El Nadi and H. Sherif (Atomic Energy Establishment, Cairo). Nucl. Phys., 55: 489-96 (July 1964).

The (^{3}He,p) stripping process on spheroidal nuclei is carried out. Nilsson's wave functions are employed to represent the two captured nucleons. General properties of the cross sections and selection rules are discussed. (auth)

36610 THE 2^- AND 0^- LEVELS IN O^{16} AND THEIR EXCITATION BY INELASTIC PROTON SCATTERING. Torbjoern Erikson (Uppsala Univ.). Nucl. Phys., 55: 497-516(July 1964).

The mixing of shell model states due to the particle-hole interaction is calculated for the levels 2^- and 0^- in ^{16}O. A zero range Soper force is used. Using a distorted wave formalism with impulse approximation, the cross sections for protons exciting these levels are calculated. From the results is concluded that the main part of the observed peak at 12.5 Mev in the inelastic proton scattering cross section can be ascribed to excitation of the 2^-, T = 1 and the 2^-, T = 0 levels. (auth)

36611 THE FISSION CROSS SECTION OF U^{232} FROM 4 ev TO 400 ev. G. D. James (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nucl. Phys., 55: 517-22(July 1964). (AERE-M-1339)

The fission cross section of ^{232}U from 4 to 400 ev was measured by time-of-flight experiment. The distribution of fission widths for eight resonances below 100 ev fits a chi-squared distribution with $\nu = 1.9 \pm 0.8$ degrees of freedom. The level spacing D is 7.6 ± 1.5 ev and the strength function $\overline{\Gamma^0}/D$ is $(1.0 \pm 0.5)10^{-4}$. (auth)

36612 THE STRUCTURE OF Li^9 AND Ca^{42} FROM THE (t,p) REACTION. J. R. Rook (Nuclear Physics Lab., Oxford). Nucl. Phys., 55: 523-8(July 1964).

The reactions $^7Li(t,p)^9Li$ and $^{40}Ca(t,p)^{42}Ca$ are analyzed using the distorted wave Born approximation. The spectroscopic factors are extracted and compared with those predicted by the shell model. In the case of ^9Li the value of the intermediate coupling parameter using a Soper force mixture is determined to be $\alpha/K = 2$. For ^{42}Ca there are some discrepancies between the values extracted from the DWBA analysis and those given by the shell model, probably indicating some degree of excitation of the ^{40}Ca core in ^{42}Ca. The angular distribution for the fourth-excited state in ^{42}Ca appears to give better agreement with the theory if its spin is assumed to be 3^- and not 4^+ as given previously. (auth)

36613 DIRECT REACTIONS AT 0° AND 180°. L. J. B. Goldfarb (Univ. of Manchester, Eng.). Nucl. Phys., 57: 4-18(Aug. 1964).

The angular distribution of radiation arising in the deexcitation of the residual nucleus following a direct reaction, can be simply predicted if measurement is made in coincidence with the reaction product, observed either in the forward or backward direction. Using a distorted-wave formalism, and limiting oneself to transfers of unique angular momentum, there usually arise only one or two unknown factors connected with the reaction, and in certain cases, these can be overdetermined by the measurement of the angular correlation. Inconsistencies would imply contributions of compound-nucleus type; otherwise the process itself requires further elaboration. If deuteron stripping is considered as an example, the results would point to the working of heavy-particle stripping or to virtual coulomb excitation. A study is also given of effects owing to polarized projectiles or targets on the intensity of reaction products at 0° and 180°. (auth)

36614 RECALIBRATION OF ALPHA PARTICLE ENERGIES. Aaldert H. Wapstra (Instituut voor Kernphysisch Onderzoek, Amsterdam). Nucl. Phys., 57: 48-54(Aug. 1964).

Energies of alpha particles emitted in ground-state transitions between nuclei with mass >190 were computed from experimental data obtained with magnetic spectrometers using the newest calibration results. (auth)

36615 MULTI-NUCLEON CAPTURE OF K^- MESONS IN COMPLEX NUCLEI. G. N. Fowler (Durham Univ., Eng.). Nucl. Phys., 57: 100-11(Aug. 1964).

A review of the experimental and theoretical material on multinucleon capture of K^- mesons is presented. It is suggested that in analogy with the photodisintegration of the deuteron for photon energies of ≈250 Mev the creation of a Y^* as an intermediate state in the capture on a pair of nucleons is crucial. In addition this process is likely to be so sensitive to two-nucleon correlations that even for correlations little stronger than in the deuteron the two-nucleon capture could be very much enhanced. (auth)

36616 DISPERSION RELATIONS AND RESONANCE REACTIONS. Clasine Van Winter (Universitet, Copenhagen). Nucl. Phys., 57: 134-51(Aug. 1964).

For one-channel scattering, a resonance formalism is developed which avoids continuing the scattering function into a region where it has resonance poles. In a non-relativistic terminology, it is assumed that for any particular partial wave the scattering function S is analytic in the energy plane cut from $-\infty$ to -1 and from 0 to ∞. It is further assumed that S satisfies a dispersion relation, and that it takes complex conjugate values at complex conjugate points. Under these assumptions, S can be written as a Blaschke product times an exponential function. The Blaschke product contains the zeros of S. At energies below the threshold for inelastic processes, it describes the resonances. If in this energy region S has isolated zeros close to the real axis, these give rise to Breit-Wigner peaks in the cross section. The exponential function corresponds to the potential scattering. It refers to a scattering process in which the real part of the phase shift is connected with the absorption at higher energies through a dispersion relation. The formalism can be extended to energies at which more than one channel is involved. This generalization is, however, not discussed. (auth)

36617 ON THE THEORY OF STRIPPING REACTIONS. D. R. Inglis (Argonne National Lab., Ill.). Nucl. Phys., 57: 271-98(Aug. 1964).

The validity of the concept of a localized elementary stripping event, as a source of waves to be superposed with appropriate phases, is investigated in simple models. The basic model is the one-dimensional deuteron encountering a simple potential step. The behavior of its two-dimensional wave equation at appropriate boundaries and limits is discussed both without the use of perturbation theory and with a perturbation theory different from a Born approximation. This one-dimensional model is extended to the case of two

or three dimensions with a potential step over an infinite face or a finite aperture. It is shown how the joining of the waves at the interface preserves the transverse momentum in such a way that the direction of emission of the proton is determined by the combined effects of the proton scattering and the internal deuteron momentum as compatible with the final behavior of the neutron. This treatment suggests that in actual nuclei the potential jump at the nuclear surface is more important as a valid source of stripping than is the constant real potential (or, in the reverse pick-up process, the bound-particle distribution) which fills the nuclear volume and provides a volume source of stripping in the Born approximation. The practical importance of the distinction is reduced in the distorted-wave Born approximation by the fact that absorption suppresses contribution from the deep interior. The deuteron absorption, predominantly near the front face, should also be treated as a source of stripping. The stripping mechanism is illustrated most simply in the Born approximation in terms of a rectangular nuclear model. (auth)

36618 DIRECT AND SEMI-DIRECT (p,γ) AND (n,γ) REACTIONS. G. E. Brown (NORDITA, Copenhagen). Nucl. Phys., 57: 339-44(Aug. 1964).

It is pointed out that, in addition to direct capture, semi-direct capture through the dipole states of nuclei is important in the region of energies near that of the dipole excitation. A schematic calculation shows that the semi-direct capture can enhance the cross sections by a factor of ~10 in the region of the giant resonance, and that its effects persist to relatively high energies. (auth)

36619 THEORY OF NUCLEAR REACTIONS. VI. UNITARITY, OPEN AND CLOSED CHANNELS. J. Humblet (Université, Liège). Nucl. Phys., 57: 386-401(Aug. 1964).

The unitarity, symmetry, and time-reversal properties of the collision matrix, given in the preceding parts for real total energies, are extended to a complex physical k-plane. The collision matrix is expanded in such a plane. The concept of open and closed channels is introduced for a resonance state with complex energy and the total width is expressed as a sum of partial widths extended over open channels only. The unitarity of the one-level approximation is discussed. (auth)

36620 PROBABLE EXISTENCE OF A 0^+ STATE IN Zn^{68}. S. Swarnagowri, A. S. Venkatesha Murthy, and M. K. Ramaswamy (Karnatak Univ., Dharwar, India). Nucl. Phys., 58: 385-7(Sept. 1964).

Kerman and Shakin proposed a model for vibrational even nuclei in which the cubic terms are included in the nuclear vibrational hamiltonian. Their results are used to fix the position of the 0^+ states in ^{68}Zn. The predicted energy ratio (1.586) of the 0^+ state to the first-excited 2^+ state is in excellent agreement with the observed energy ratio (1.552), which implies a 0^+ state at 1.66 Mev. A 4^+ state at 2.013 Mev, which was not so far observed, is predicted from this theory. (auth)

36621 EFFECTIVE INTERACTION CALCULATIONS OF ENERGY LEVELS AND WAVE FUNCTIONS IN THE NUCLEAR 1p SHELL. D. Amit and A. Katz (Weizmann Inst. of Science, Rehovoth, Israel). Nucl. Phys., 58: 388-406(Sept. 1964).

The effective interaction method is applied to the 1p shell in intermediate coupling in nuclei from ^5He to ^{16}O. No assumption is made on the form of the forces or the potential well. A fixed set of two-body matrix elements of the effective interaction is obtained which reproduces all total (binding) energies of low-lying energy levels for $8 \leqq A \leqq 16$. The wave functions of the levels considered are also obtained. The agreement with experiment is in many instances an improvement upon the work of Kurath. This shows that the postulation of a specific form of the interaction is a rather severe restriction. Since absolute energy values are obtained, it is possible to make predictions on the stability of nuclei so far undetected. Finally, the situation regarding nuclei with $A < 8$ is discussed. (auth)

36622 THE MEAN LIFE AND NUCLEAR DEFORMATION OF THE 98-kev LEVEL IN ^{153}Eu. W. D. Hamilton and K. E. Davies (Univ. of Sussex, Brighton, Eng.). Nucl. Phys., 58: 407-16(Sept. 1964).

The nuclear resonant scattering cross section for 98-kev γ rays was evaluated relative to that for Rayleigh scattering. The resonant condition was provided by the overlap of the thermally broadened emission and absorption levels. The scattering cross section gave a mean life for γ decay of $(2.28 \pm 0.18) \times 10^{-10}$ sec and on the basis of the Nilsson model the deformation parameter of the 98-kev level was found to be $\delta = 0.20 \pm 0.01$ when $\delta = 0.30$ for the ground state, and the parameter μ has the values 0.55 and 0.70 for the ground and excited states respectively. (auth)

36623 INTERNAL CONVERSION COEFFICIENTS OF Ni^{56}. R. C. Jenkins and W. E. Meyerhof (Stanford Univ.). Nucl. Phys., 58: 417-31(Sept. 1964).

The internal conversion coefficients of the 0.164, 0.272, and 0.484-Mev gamma rays of ^{56}Ni were determined utilizing a scintillation gamma ray spectrometer and a Siegbahn-Slätis intermediate-image beta-ray spectrometer. Respective conversion coefficients of $(1.2 \pm 0.1) \times 10^{-2}$, $(3.4 \pm 0.2) \times 10^{-3}$ and $(1.5 \pm 0.15) \times 10^{-3}$ were found. Comparison with theoretical conversion coefficients expected for pure multipole transitions and use of the Weisskopf single-particle estimates for the gamma-ray transition probabilities lend considerable support to an analysis of the low-excited states of ^{56}Co in terms of a simple shell model for an odd nucleus. (auth)

36624 SEMICLASSICAL THEORY OF POLARIZATION IN DIRECT NUCLEAR REACTIONS. A. Y. Abul-Magd and M. El-Nadi (Atomic Energy Establishment, Cairo). Nucl. Phys., 58: 439-48(Sept. 1964).

The semiclassical correlation theory of Biedenharn is used to study the polarization of emitted particles and residual nuclei in direct nuclear reactions in the absence of spin orbit interaction of incident and emitted particles. The obtained results are in agreement with previous quantal calculations. (auth)

36625 AN EMPIRICAL CORRELATION CONCERNING log ft VALUES OF BETA-TRANSITIONS TO VIBRATIONAL LEVELS IN EVEN NUCLEI. S. M. Brahmavar, A. S. Venkatesha Murthy and M. K. Ramaswamy (Karnatak Univ., Dharwar, India). Nucl. Phys., 58: 449-52(Sept. 1964).

An empirical relation log ft (2′)/log ft (2) = K E(2′)/E(2), where K = (0.52 ± 0.05) connecting the energy-ratios and the log ft values of beta transitions to vibrational levels of even nuclei is proposed. (auth)

36626 INVESTIGATION OF THE REACTION $Li^7(p,\alpha)He^4$ INDUCED BY POLARIZED PROTONS WITH ENERGY 2-3.5 Mev. F. Asfour, I. Bondouk, V. J. Gontchar, V. A. Loutsik, F. Machali, and I. I. Zaloubovsky (Atomic Energy Establishment, Cairo). Nucl. Phys., 58: 453-7(Sept. 1964).

The sensitivity of the reaction $^7Li(p,\alpha)^4He$ with respect to proton polarization was measured in the energy range 2-3.5 Mev. Polarized protons were obtained from the reaction $^{12}C(d,p)^{13}C$. (auth)

36627 SPECTRUM OF γ-RAYS FROM THE $Fe^{56}(n,\gamma)Fe^{57}$ REACTION. L. V. Groshev, A. M. Demidov, G. A. Kotelnikov, and V. N. Lutsenko (Kurchatov Inst. of Atomic Energy, Moscow). Nucl. Phys., 58: 465-76(Sept. 1964).

Measurements are given of a spectrum of γ rays emitted in radiative capture of thermal neutrons by Fe nuclei. Energies and intensities are determined for 61 lines. A ^{57}Fe γ-transition scheme is constructed on the basis of the data obtained. Radiative properties of the levels of this nucleus are discussed. From a comparison of yields in the (n,γ) and (d,p) reactions on ^{56}Fe as well as from the data on ^{57}Fe level decay it is concluded that the direct capture does not play the main role in the absorption of a thermal neutron by ^{56}Fe. (auth)

36628 THE DECAY MODE OF THE FIRST EXCITED STATE OF He^6. K. Huenchen, F. Kropf, and H. Waeffler (Max-Planck-Institut für Chemie, Mainz). Nucl. Phys., 58: 477-80(Sept. 1964).

The branching ratio for a gamma transition from the first excited state of ^6He (2^+, 1.71 Mev) was measured to be $\Gamma_\gamma/\Gamma_n < 4 \times 10^{-4}$. (auth)

36629 EQUILIBRIUM DEFORMATIONS OF ISOMERS IN THE REGION 50 ≦ Z AND N ≦ 82. F. Demichelis and F. Iachello (Istituto di Fisica Sperimentale del Politecnico, Turin). Nucl. Phys., 58: 481-90(Sept. 1964).

Equilibrium deformations of the isomers in the region 50 ≦ Z and N ≦ 82 are calculated using Nilsson's single-particle model. The values of some Nilsson parameters which give a predicted level sequence in agreement with the experimental one are established. Finally, a tentative interpretation is given of the singular occurrence of nearly all odd-neutron isomers in this region. (auth)

36630 L/K CAPTURE RATIOS IN Xe^{127} DECAY. M. Bresesti, F. Cappellani, and A. M. Del Turco (CCR-EURATOM, Ispra, Italy). Nucl. Phys., 58: 491-6(Sept. 1964).

The L/K ratios for the ^{127}Xe electron capture decay to the 377- and 204-kev excited states of ^{127}I were measured by the x-γ coincidence method. The disintegration energy and the log ft values were calculated. The results are disintegration energy = 543 kev, log ft = 5.68 ± 0.12 (electron capture to the 377-kev level) and log ft = 6.32 ± 0.03 (electron capture to the 204-kev level). (auth)

36631 OPTICAL MODEL STUDIES OF PROTON SCATTERING AT 30 Mev. I. DIFFERENTIAL CROSS SECTIONS FOR ELASTIC SCATTERING OF PROTONS AT 30.3 Mev. B. W. Ridley and J. F. Turner (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nucl. Phys., 58: 497-508(Sept. 1964).

Differential cross sections for proton elastic scattering were measured as part of an extensive program of optical model studies being carried out with the linear accelerator. Results were obtained for 30.3-Mev protons at 2° angular intervals on seven isotopes ^{40}Ca, ^{56}Fe, ^{59}Co, ^{58}Ni, ^{60}Ni, ^{120}Sn, and ^{208}Pb. Less detailed measurements were also carried out at this energy on ^{12}C, ^{16}O, and a natural mixture of Cu isotopes. (auth)

36632 OPTICAL MODEL STUDIES OF PROTON SCATTERING AT 30 Mev. II. PROTON TOTAL REACTION CROSS SECTIONS AT 28.5 ± 1.5 Mev. J. F. Turner, B. W. Ridley, P. E. Cavanagh, G. A. Gard, and A. G. Hardacre (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nucl. Phys., 58: 509-14(Sept. 1964).

Proton total reaction cross sections were measured as part of an extensive program of optical model studies being carried out with the linear accelerator. A beam attenuation technique was used. Results were obtained at an energy of 28.5 ± 1.5 Mev for ^{40}Ca(913 ± 38 mb), ^{56}Fe(1140 ± 43 mb), ^{59}Co(1169 ± 39 mb), ^{58}Ni(1038 ± 32 mb), ^{60}Ni(1053 ± 51 mb), ^{120}Sn(1638 ± 68 mb), and ^{208}Pb(1865 ± 98 mb). (auth)

36633 OPTICAL MODEL STUDIES OF PROTON SCATTERING AT 30 Mev. III. POLARIZATION IN ELASTIC SCATTERING BY Ca, Co^{59}, Ni^{58}, Ni^{60}, Sn^{120}, AND Pb^{208}. R. M. Craig (Univ. of Birmingham, Eng.), J. C. Dore, G. W. Greenlees, J. S. Lilley, J. Lowe, and P. C. Rowe. Nucl. Phys., 58: 515-21(Sept. 1964).

Angular distributions are presented of the polarization produced in the elastic scattering of 30-Mev protons in the angular range 20–120° (lab). Results for Ca, ^{59}Co, ^{58}Ni, ^{60}Ni, ^{120}Sn, and ^{208}Pb show the characteristic oscillations well known at lower energies but exhibit higher maximum polarizations in general. The technique used involved the single scattering of a 30-Mev polarized proton beam. (auth)

36634 MECHANISM OF THE $^{32}S(^3He,\alpha)^{31}S$ REACTION AT BOMBARDING ENERGIES OF 4.60, 5.05 AND 5.50 Mev. I. Filosofo, Z. Konieczny, and F. Pellegrini (Università, Padua and Istituto Nazionale di Fisica Nucleare, Padua). Nucl. Phys., 58: 522-8(Sept. 1964).

Angular distribution of alpha particles from the $^{32}S(^3He,\alpha)^{31}S$ reaction, leading to the ground state of ^{31}S, was measured at bombarding energies of 4.60, 5.05, and 5.50 Mev, using a semiconductor device as detector. The angular distributions show typical oscillatory behavior with pronounced peaks in the backward direction, which are very sensitive to the bombarding energy. The experimental results were fitted by the square of an expansion of Legendre polynomials according to the formalism of the DWBA pick-up theory, for the particular case of a momentum transfer l = 0. The coefficients of the Legendre polynomials, extracted from the experimental results, are peaked mostly near the classical cut-off, indicating a process of pick-up mechanism under condition of strong absorption. In addition, the presence of a large coefficient for the s partial waves seems to indicate that a compound nucleus mechanism is present, interfering with the direct interaction. (auth)

36635 LIMITATIONS TO METHODS OF ENERGY DETERMINATION OF ELECTROMAGNETIC CASCADES. K. Pinkau (Universität, Kiel). Nuovo Cimento (10), 33: 221-36(July 1, 1964).

An estimate is made of how far away from the core of electromagnetic cascades one may extend measurements and assume that the number distribution of electrons is given by the unique functions of $E_\theta \times R$ usually employed for energy determination. It is shown that, particularly in dense stacks, these unique functions cease to be valid rather close to the core. From the evidence presented it appears that the method to determine cascade energies was possibly employed in the past beyond its region of validity. The implications on measurements of energy spectra are briefly discussed. (auth)

36636 THREE-BODY FINAL STATES FROM $\bar{K}$ CAPTURE IN HELIUM FOUR AND THE $P_{\frac{3}{2}}$ RESONANCE Y_1^*. [PART] I. J. Sawicki (Laboratoire Joliot-Curie de Physique Nucléaire, Orsay, France). Nuovo Cimento (10), 33: 361-71(July 16, 1964).

The reaction $\bar{K} + {}^4He \rightarrow \Lambda + \pi^- + {}^3He$ with the formation of the Y_1^* resonance in the intermediate state is investigated. An impulse approximation is used with the t-matrix of the Breit-Wigner form corresponding to the $P_{\frac{3}{2}}$ wave of

the Y_1^*. The reaction rates are calculated for the capture at rest with the relativistic pion kinematics. The calculated ^{3}He and pion-momentum distributions agree reasonably well with the data. The angular distribution of the three final-state particles and the problem of the Λ-^{3}He final-state distortion are discussed. (auth)

36637 DIPOLE EXCITATIONS OF P-SHELL NUCLEI. G. F. Nash (Wadham Coll., Oxford). Nuovo Cimento (10), 33: 462-7(July 16, 1964).

The longitudinal dipole vibrations of p-shell nuclei are classified by their supermultiplet and unitary quantum numbers, and their excitation energy is evaluated using a two-body interaction acting in the various relative states of motion of the nucleons. The first resonance was found to be highest for 4n nuclei and a few Mev lower for intermediary nuclei, varying in a regular way. (auth)

36638 PHOTONS AND ELECTRONS IN NUCLEAR PROCESSES. I. RELATIONS BETWEEN THE DIFFERENTIAL CROSS-SECTIONS FOR THE PHOTON AND ELECTRON-DISINTEGRATION IN THE TWO-BODY SYSTEMS. B. Bosco (Stanford Linear Accelerator Center, Calif. and Università, Turin) and P. Quarati. Nuovo Cimento (10), 33: 527-44(July 16, 1964).

The relations between the photon and electron processes in the two-body systems are investigated for all multipoles. It is shown that all the multipoles, both electric and magnetic, with the exception of the even electric multipoles, are determined in photon and electron phenomena by the same parameters. For the even electric multipoles the electron disintegration involves the zero-zero transitions which are not present in the photodisintegration. The construction of the interference terms between different multipoles is discussed. (auth)

36639 THE $(p,p\alpha)$ AND $(\alpha,2\alpha)$ REACTIONS. Y. Sakamoto (National Research Council, Ottawa). Nuovo Cimento (10), 33: 566-77(July 16, 1964).

The $(p,p\alpha)$ and $(\alpha,2\alpha)$ reactions are discussed in terms of the momentum distribution function for the mass center of the four nucleons to be knocked out as an alpha particle and of the probability of finding the alpha particle within the nucleus. The momentum distribution for the mass center of the four nucleons within the nucleus is the same for both the reactions. The probability of finding the alpha particle inside the nucleus in the $(\alpha,2\alpha)$ reaction is compared with the corresponding probability in the $(p,p\alpha)$ reaction. (auth)

36640 THE MAGNETIC MOMENT OF Ni^{61}. L. E. Drain (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Phys. Letters, 11: 114-15(July 15, 1964).

The magnetic moment of ^{61}Ni was determined from NMR measurements in nickel carbonyl. Measurements were made with a crossed coil magnetic resonance spectrometer in fields from 11 to 18 kgauss. The magnetic moment was found to be -0.74868 ± 0.00004 nuclear magnetons. (C.E.S.)

36641 ANALYSIS OF FLUCTUATIONS ON $Al^{27}(d,\alpha)Mg^{25}$ AND $Al^{27}(d,p)Al^{28}$ REACTIONS. E. Gadioli, G. M. Marcazzan, and G. Pappalardo (Università, Milan). Phys. Letters, 11: 130-4(July 15, 1964).

The reactions ^{27}Al(d,α)^{25}Mg and ^{27}Al(d,p)^{28}Al were investigated at 1.4 to 2.3 Mev. The excitation energy of the compound nucleus ^{29}Si was about 20 Mev. On the basis of the statistical model, the value of the density and average width of the compound nucleus levels were calculated. From these calculations it is concluded that overlapping of compound nucleus levels occurs in this energy range. The differential excitation functions, angular distributions, integrated cross sections, and auto-correlation functions are presented. (C.E.S.)

36642 ISOBARIC ANALOGUE STATES OF Zr^{90} FROM $Y^{89}(p,\gamma)Zr^{90}$. J. L. Black and N. W. Tanner (Oxford Univ.). Phys. Letters, 11: 135-6(July 15, 1964).

Measurements were made on the excitation function and angular distributions of the ^{89}Y(p,γ)^{90}Zr reaction at 5.5 to 8.5 Mev. The excitation functions have two sharp resonances at 6.15 and 8.04 Mev. Angular distributions were measured at the peaks of the two sharp resonances and it appears probable that the 6.15- and 8.04-Mev peaks are, respectively, s-wave and d-wave resonances for dipole radiation both having T = 6. (C.E.S.)

36643 CROSS SECTIONS OF THE REACTIONS $He^3(\gamma,p)D^2$ AND $He^3(\gamma,n)2p$. A. N. Gorbunov and A. T. Varfolomeev (Lebedev Inst. of Physics, Moscow). Phys. Letters, 11: 137-9(July 15, 1964).

A cloud chamber filled with ^{3}He at a pressure of 0.9 atm and placed in a magnetic field of 10,400 Oe to investigate the ^{3}He(γ,p)D and ^{3}He(γ,n)2p reactions at bremsstrahlung energies of 5 to 120 Mev. The cross sections were determined for each reaction. (C.E.S.)

36644 THE GROUND-STATE CONFIGURATION OF Zr^{90}. J. L. Yntema (Argonne National Lab., Ill.). Phys. Letters, 11: 140-1(July 15, 1964).

An attempt was made to determine the value of the parameter a^2 in the ^{90}Zr wave function by detecting the presence of $g_{9/2}$ protons by means of the ^{90}Zr(d,^{3}He)^{89}Y reaction at 21.4 Mev. The angular distributions for the ground-state transition and for the transition to the 915-kev state are also presented. (C.E.S.)

36645 AVERAGE LEVEL WIDTH OF THE COMPOUND NUCLEUS. K. Tsukada and Tsong Jen Lee (Japan Atomic Energy Research Inst., Tokyo). Phys. Letters, 11: 141-5(July 15, 1964).

The ratio $\langle\Gamma\rangle/D$ of the compound nuclei C, Al, Si, S, Ti, Cr, Mn, Fe, Ni, Co, Cu, Zn, Cd, and Pb was obtained. A neutron beam of 4 to 5 Mev was used, and the excitation functions, total cross sections, elastic scattering cross sections, and compound elastic scattering cross sections are tabulated. (C.E.S.)

36646 EVEN-PARITY-HOLE STATES IN $f_{7/2}$-SHELL NUCLEI. R. K. Bansal and J. B. French (Univ. of Rochester, N. Y.). Phys. Letters, 11: 145-8(July 15, 1964).

It is shown that the approximate energies of even-parity-hole states in $f_{7/2}$-shell nuclei can be calculated in terms of certain binding energies that are already available and certain parameters of the interaction between the hole and the $f_{7/2}$ particles. Calculations are presented for scandium and titanium isotopes. (C.E.S.)

36647 POTASSIUM-45. H. Morinaga and G. Wolzak (Instituut voor Kernphysisch Onderzoek, Amsterdam). Phys. Letters, 11: 148-50(July 15, 1964).

During a search for short-lived activities produced in bombardments of ^{48}Ca by 52-Mev α particles, a new activity, which was assigned to ^{45}K, was detected. The decay characteristics were studied and are discussed. (C.E.S.)

36648 COULOMB ENERGY OF He^3 AND POSSIBLE CHARGE ASYMMETRY OF NUCLEAR FORCES. K. Okamoto (North Japan Coll., Tagajo, Japan). Phys. Letters, 11: 150-3(July 15, 1964).

Possible charge asymmetry of nuclear forces is con-

sidered by investigating the coulomb energy of ^{3}He. The calculations take into account the hard core effect, proton finite size, and a mixed symmetry S state. (C.E.S.)

36649 NUCLEAR FORCE AND ENERGY GAP IN FINITE NUCLEI. S. Nagata and H. Bandō (Kyoto Univ.). Phys. Letters, 11: 153-4(July 15, 1964).

Previous calculations that showed an energy gap of zero or a negligible value in infinite nuclear matter and an energy gap of reasonable value in finite nuclei are considered. The mechanism responsible for this difference is discussed. Calculations for ^{60}Ni are used as an example. (C.E.S.)

36650 A NOTE ON THE ELECTROMAGNETIC STRUCTURE OF He^3 AND H^3. T. A. Griffy (Stanford Univ., Calif.). Phys. Letters, 11: 155-6(July 15, 1964).

The effect of small admixtures of a $T = {}^3/_2$ component in the ^{3}He wave function on the validity of the electromagnetic form factor analysis of ^{3}He and ^{3}H is investigated. (C.E.S.)

36651 ANOMALOUS LEVEL ORDERING IN Mg^{24} AND Ne^{22}. Carla Abulaffio (Israel Inst. of Tech., Haifa). Phys. Letters, 11: 156-8(July 15, 1964).

A calculation is made, using the Elliott classification, for the five lowest energy levels of ^{22}Ne assuming a pure (8.2) configuration, a two-body nuclear potential, and a harmonic oscillator length parameter b = 1.64 f for the sd shell. Results for ^{24}Mg, ^{28}Si, and ^{20}Ne are also discussed. (C.E.S.)

36652 MODEL FOR HYPERFRAGMENT PRODUCTION. A. Avni, M. Friedmann, and D. Kessler (Soreq Research Establishment, Rehovoth, Israel). Phys. Letters, 11: 174-5(July 15, 1964).

Two models for the production of hyperfragments in meson (K^-) capture at rest in nuclear emulsions are proposed. In the prompt model the hyperfragment is produced by direct interaction of the meson (K^-) with a nuclear cluster. In the second model the meson (K^-) may produce a hyperon (Λ) either directly or via Σ-conversion, and the hyperon (Λ) eventually becomes trapped in the excited nucleus. The hyperfragment is subsequently emitted in the de-excitation process. Alternatively the hyperon (Λ) may remain trapped in the nucleus after completion of the de-excitation to form a cryptofragment. (C.E.S.)

36653 THE FREQUENCY OF EMISSION OF Li^8 FRAGMENTS FROM THE INTERACTIONS OF K^- MESONS OF 1.3 AND 1.5 Gev/c MOMENTA WITH HEAVY EMULSION NUCLEI. W. Gajewski, J. Suchorzewska, M. F. Votruba, and J. Zakrzewski (Univ. of Warsaw and Inst. for Nuclear Research, Warsaw). Phys. Letters, 11: 177-8(July 15, 1964).

The emission of ^{8}Li fragments from the reactions of mesons (K^-) of 1.3 and 1.5 Bev/c momenta with heavy emulsion nuclei (Br,Ag) was investigated. The frequency of emission of ^{8}Li fragments is compared with results obtained for proton reactions with emulsion nuclei at 9 and 24 Bev, and it is concluded that the probability of emission of ^{8}Li fragments depends neither on the type nor the energy of the incident particles. (C.E.S.)

36654 RATIO OF THE QUADRUPOLE MOMENT OF THE FIRST EXCITED STATE OF Xe^{129} TO THAT OF THE GROUND STATE OF Xe^{131}. Gilbert J. Perlow (Argonne National Lab., Ill.). Phys. Rev., 135: B1102-5(Sept. 7, 1964).

The Mössbauer effect in ^{129}Xe and ^{131}Xe contained in XeF_4 was used to measure the ratio of electric quadrupole moments of the lowest $^3/_2{}^+$ states in the two isotopes. This is the ground state in ^{131}Xe and the first excited state in ^{129}Xe. The value $Q(^{129*}Xe)/Q(^{131}Xe) = 3.45 \pm 0.09$ is obtained. The sign of the moment in ^{129}Xe is obtained by use of a source containing oriented crystals of $^{129}KICl_4$ which produces $XeCl_4$ in its beta decay. The quadrupole moment is found to be negative. The known quadrupole moment of the ground state of ^{131}Xe, −0.12b, then gives $Q(^{129*}Xe) = -0.41b$. The large ratio of the moments is interpreted as due to the abrupt onset of a region of permanent deformation by analogy with a similar situation in the europium isotopes. Discussions of such a region appear in the literature. The linewidth observed in ^{131}Xe yields a value for the first-excited-state lifetime, $T_{1/2} = 0.504 \pm 0.017$ nsec, in good agreement with delayed-coincidence measurements. The measured value for the ratio of the moments removes a difficulty in understanding the structure of xenon fluorides generated by an earlier assumption that the ratio was unity. (auth)

36655 RECOIL STUDIES OF NUCLEAR REACTIONS INDUCED BY HIGH-ENERGY PARTICLES. I. PRODUCTION OF Tb^{149}. Lester Winsberg (Argonne National Lab., Ill. and Univ. of California, Berkeley). Phys. Rev., 135: B1105-18(Sept. 7, 1964).

The interaction of high-energy protons and alpha particles with Ta, Au, and Bi to produce ^{149}Tb was investigated by the recoil technique and by measuring the excitation functions. The experimental results were analyzed in terms of a two-step mechanism: An initial interaction causes the struck nucleus to recoil forward. This excited nucleus then loses its energy of excitation by emitting various particles until the final nucleus is formed. The results of this analysis confirm the main features of this mechanism. These results were further analyzed for the details of the mechanism by applying the laws of energy and momentum conservation in a general way. (auth)

36656 NUCLEAR STRUCTURE EFFECTS IN "ELASTIC" NEUTRINO-INDUCED REACTIONS. B. Goulard and H. Primakoff (Univ. of Pennsylvania, Philadelphia). Phys. Rev., 135: B1139-52(Sept. 7, 1964).

The effects of nuclear structure on elastic neutrino-induced reactions: $\nu_\mu + [Z,A] \rightarrow \mu^- + [Z+1,A]$, $\bar{\nu}_\mu + [Z,A] \rightarrow \mu^+ + [Z-1,A]$, are considered by use of methods analogous to those developed in the theory of muon capture by complex nuclei. A nuclear structure effect quantity (n.s.e.q.), which allows calculation of the cross sections for $\nu_\mu + n \rightarrow \mu^- + p$ and $\bar{\nu}_\mu + p \rightarrow \mu^+ + n$ from the observed cross sections for $\nu_\mu + [Z,A]_0 \rightarrow \mu^- + [Z+1,A]_{all}$ and $\bar{\nu}_\mu + [Z,A]_0 \rightarrow \mu^+ + [Z-1,A]_{all}$, is derived and discussed. This n.s.e.q. is, to a reasonable approximation, independent of the nucleon form factors associated with the lepton-hadron weak interaction and essentially involves only the nucleon-nucleon correlation function of $[Z,A]_0$ as determined by the internucleon forces and the exclusion principle. Finally, it is shown how the nuclear parameters entering into the nucleon-nucleon correlation function can be found from existing empirical data on electron scattering and muon capture by complex nuclei and, with use of the so-determined values of these parameters, values of the n.s.e.q. for various [Z,A] and E_ν are given. (auth)

36657 DIFFRACTION MODEL FOR DIRECT REACTIONS. E. M. Henley and D. U. L. Yu (Univ. of Washington, Seattle). Phys. Rev., 135: B1152-60(Sept. 7, 1964). (TID-20730)

A diffraction model for direct reactions which were pro-

posed earlier is extended. The simple model provides physical insight into the effects of nuclear optical-model potential distortions without the necessity of performing complex numerical integrations. It is particularly useful, and can be qualitatively justified, for direct reactions when strong absorption is present in both the incident and exit channels and the center-of-mass wave function of the bound state involved corresponds to a small binding energy or to a long exponential tail. Thus, it is expected to be especially applicable to intermediate-energy complex-particle reactions such as the (^{3}He,d) and (α,t) processes. The forward-angle approximations made earlier are removed so that time-reversal symmetry is restored. Proper bound-state wave functions outside the nucleus are employed. Coulomb effects are briefly discussed. The assumptions of the model are thus made less drastic, but at the expense of decreasing mathematical simplicity. Predictions based on the earlier version are essentially unaffected, so that the simple forward-angle model remains useful up to moderately large angles. This is illustrated by comparisons with experiments. (auth)

36658 ELECTRON-PROTON COINCIDENCE CROSS SECTION FOR He^3 AND H^3. T. A. Griffy and R. J. Oakes (Stanford Univ., Calif.). Phys. Rev., 135: B1161-7(Sept. 7, 1964).

The cross section is given in the impulse approximation for inelastic e-^{3}He and e-^{3}H scattering assuming an ejected proton is counted in coincidence with the scattered electron. The process e + ^{3}He → d + p + e′ is considered in detail. This cross section is evaluated for the Gaussian, Irving, and Irving-Gunn three-body wave functions, the deuteron being described by a Hulthén wave function. The best agreement with the preliminary experimental results is obtained using the Irving-Gunn wave function. (auth)

36659 ELASTIC AND INELASTIC SCATTERING OF 13- TO 19-Mev PROTONS BY O^{16}. W. W. Daehnick (Princeton Univ., N. J. and Univ. of Pittsburgh). Phys. Rev., 135: B1168-79(Sept. 7, 1964). (PUC-1964-141)

Closely spaced differential cross sections were obtained for elastic and inelastic scattering of protons by ^{16}O ($0 \geq Q \geq -8.88$ Mev). At laboratory angles of 80, 100, 120, 140, and 160°, continuous elastic excitation curves over the energy range from 13 to 19 Mev were obtained by a thick-target technique. For proton energies between 14.8 and 19.2 Mev, additional measurements with about 200-kev energy resolution were made by conventional thin-target techniques. Numerical values of cross sections for elastic and inelastic scattering are presented for the angular range from 15 to 160° at typically 10° angular and 200-kev energy intervals. Differential cross sections often change by a factor of 2 within 200-500 kev for large as well as small angles. The largest resonance is found at 14.9 Mev, but fluctuations at the upper end of the energy scale (≈19 Mev), particularly for inelastic scattering, are not significantly smaller. Some, but not all, of these strong fluctuations occur slightly above the five reactions thresholds (p,2p), (p,d), (p,^{3}He), (p,pn), (p,n) in the 12- to 19-Mev region. Previously, nine of the elastic angular distributions reported were made available for analysis by the use of an optical-model search code. Fits to within 10% were obtained, but the optical-model parameters for good fits showed strong energy dependence. It is suggested that simple potential scattering provides an insufficient explanation for ^{16}O(p,p)^{16}O for the energy region investigated. The interference of potential scattering with compound nuclear scattering is discussed and shown to be very noticeable, even for 200-kev energy resolution. Data and analysis emphasize the need for a theoretical approach to scattering which takes explicit account of easily formed states in light nuclei. (auth)

36660 DIFFERENTIAL CROSS SECTIONS OF THE $Li^6(N^{14},\alpha)O^{16}$ AND $Li^7(N^{14},\alpha)O^{17}$ REACTIONS. John W. Wachter (Univ. of Tennessee, Knoxville and Oak Ridge National Lab., Tenn.). Phys. Rev., 135: B1180-5(Sept. 7, 1964).

The angular distributions of α particles from the bombardment of ^{6}Li and ^{7}Li by 27.6-Mev incident nitrogen ions were measured from 0 to 135° c.m. Both α and recoil particles were detected in coincidence by silicon surface-barrier diodes. In the ^{6}Li measurements the ^{16}O recoil was left in its ground state; ^{7}Li measurements did not resolve reactions leading to the ground state and to the 870-kev excited state of ^{17}O. The ^{6}Li distribution exhibits a strong forward peak of approximately 75 μb/sr at 0° c.m., falling off, with some structure, to about 10 μb/sr at 90° c.m. at the backward angles, the cross section rises to a broad peak of 18 μb/sr at 112.5° c.m., falling to 9 μb/sr at 135° c.m. The ^{7}Li distribution is of similar shape at forward angles, falling from 140 to 30 μb/sr, but at backward angles rises to 84 μb/sr at 135° c.m. without clearly defined structure or symmetry with the cross section at forward angles. Calculation shows that the reactions do not proceed via a compound nucleus. The ^{6}Li reaction is treated as a deuteron transfer reaction using a modified tunneling theory and a distorted-wave calculation. (auth)

36661 MÖSSBAUER EFFECT IN IRON UNDER VERY HIGH PRESSURE. D. N. Pipkorn, C. K. Edge, P. Debrunner, G. De Pasquali, H. G. Drickamer, and H. Frauenfelder (Univ. of Illinois, Urbana). Phys. Rev., 135: A1604-12 (Sept. 14, 1964).

The Mössbauer spectrum of ^{57}Fe in iron metal was measured at pressures up to 240 kbar at room temperature. Below 130 kbar the spectrum consists of the normal six lines characteristic of ferromagnetic body-centered-cubic iron. The internal magnetic field H at the nucleus decreases linearly with volume; $\partial(H/H_0)/\partial(V/V_0) = 0.34 \pm 0.01$, where H_0 and V_0 are the field and volume at atmospheric pressure. The center of gravity of the spectrum shifts with pressure, indicating an increase in s-electron density at the nucleus. The initial variation, -8.3×10^{-5} cm sec^{-1} kbar^{-1}, is consistent with scaling the 4s wave function with volume, while at higher pressures the variation is slower. Above 130 kbar a seventh line appears near the center of the spectrum due to the transformation of part of the iron source to the hexagonal-close-packed high-pressure phase. With increasing pressure this line becomes more intense and the split spectrum disappears, although the transformation is sluggish. From the absence of splitting and from the observed linewidth it is concluded that the internal field in the hexagonal phase is 0 ± 3 kg. There may be a small broadening due to electric quadrupole interactions in the hexagonal lattice. The isomer shift of the hexagonal phase relative to the cubic phase is −0.017 cm/sec, indicating that the s-electron density is greater in the hexagonal phase. The pressure dependence of the shift in the hexagonal phase is very slight and is not consistent with scaling the 4s wave function with volume. Apparatus and experimental techniques that were developed for measuring the Mössbauer spectra of sources under pressure are described. (auth)

36662 ATOMIC-BEAM STUDIES OF NUCLEAR PROPERTIES OF SOME RARE-EARTH ISOTOPES. Burton Budick, Isaac Maleh, and Richard Marrus (Univ. of California, Berkeley). Phys. Rev., 135: B1281-7(Sept. 21, 1964). (UCRL-11345)

A study was made of the nuclear spins I and hyperfine structures of several radioisotopes in the rare-earth region. The nuclear-spin determinations are $^{143}Pr(I = 7/2)$, $^{149}Nd(I = 5/2)$, $^{161}Tb(I = 3/2)$, $^{161}Ho(I = 7/2)$, and $^{165}Er(I = 5/2)$. The measured hyperfine constants are: for ^{171}Eu, $|A| = 197.0(2.9)$Mc, $|B| = 3646(106)$ Mc, $B/A > 0$; and for ^{171}Tm, $|A| = 372.1(5.9)$ Mc, and the moments inferred from them are: for ^{171}Er, $|\mu_I| = 0.70(5)$ nm, and for ^{171}Tm, $|\mu_I| = 0.227(5)$ nm. A discussion of these values in terms of the various nuclear models is included. (auth)

36663 SHELL MODEL AND THE LEVELS OF Zr^{91}. S. Ramavataram (Univ. of Michigan, Ann Arbor). Phys. Rev., 135: B1288-94(Sept. 21, 1964).

A shell-model interpretation of low-lying positive-parity states of ^{91}Zr was attempted by taking into account the residual interactions between the two protons in the $2p_{1/2}$ and $1g_{9/2}$ configurations coupled to a neutron in the $2d_{5/2}$, $3s_{1/2}$, $1g_{7/2}$, and $2d_{3/2}$ single-particle states. A finite-range, central two-body force with a Gaussian radial dependence was assumed. Data on other nuclei in this mass region were analyzed to provide a set of model parameters. Qualitative agreement was obtained with the experimental data on ^{91}Zr. (auth)

36664 COMPARISONS OF BCS NUCLEAR WAVE FUNCTIONS WITH EXACT SOLUTIONS. M. Rho and J. O. Rasmussen (Univ. of California, Berkeley). Phys. Rev., 135: B1295-1301(Sept. 21, 1964). (UCRL-11224)

The validity of the Bardeen-Cooper-Schrieffer variational method is re-examined for two nuclear-model cases, one resembling the system of deformed nuclei and the other spherical nuclei. For simplicity, a constant-pairing-force approximation is adopted. The projected BCS wave functions compare badly with the exact wave functions at pairing-force strength around the critical force strength, and only for sufficiently strong pairing forces does the BCS method seem to approach the exact. For the spherical case, the average value of the pair operator $(\frac{1}{2}N)$ is also calculated over a wide range of force strength, and the general behavior is found to be consistent with the results obtained on the wave-function components. The errors in eigenvalues are computed, and discussions are given as to the possible sources of the deviations. (auth)

36665 NEW ISOTOPE In^{124}. M. Karras (Univ. of Arkansas, Fayetteville). Phys. Rev., 135: B1301-2 (Sept. 21, 1964).

Irradiation of ^{124}Sn samples with 14–15-Mev neutrons was found to produce a new radioactive nuclide which was assigned to ^{124}In. The following radiation characteristics were observed to belong to the decay of ^{124}In: half life, 3.6 ± 1.0 sec; beta end-point energy, 5.3 ± 0.8 Mev; gamma rays having energies 1.13 ± 0.01, 0.99 ± 0.02, and 3.21 ± 0.03 Mev, and relative intensities 100, 33 ± 7, and 33 ± 7, respectively. (auth)

36666 SHELL-MODEL CALCULATION OF THE EVEN-PARITY STATES OF Ne^{20}. James D. Talman (Univ. of California, Davis). Phys. Rev., 135: B1302-6(Sept. 21, 1964).

The nuclear shell model was applied to calculate the positive-parity energy levels of ^{20}Ne. The problem of four interacting particles in the 2s-1d shell was solved for low-lying states using a technique which is particularly suited to automatic computation. The resulting energy levels are in quite good agreement with the experimental results for a reasonable internucleon potential. (auth)

36667 MULTIPOLE MIXTURES IN THE MÖSSBAUER EFFECT. J. T. Dehn, J. G. Marzolf, and J. F. Salmon (RINS, Woodstock Coll., Md.). Phys. Rev., 135: B1307-10(Sept. 21, 1964).

A theory of multipole mixtures applicable to resonance absorption is developed. The method used is an extension of Malus' law to include elliptically polarized multipole mixtures. The case of dipole-quadrupole mixtures is treated in detail as a means of measuring E2/M1 mixing ratios and checking time-reversal invariance in certain nuclei. (auth)

36668 BETA DECAY OF Y^{90m}. Philip W. Davis, Jean Kern, and Raymond K. Sheline (Florida State Univ., Tallahassee). Phys. Rev., 135: B1310-12(Sept. 12, 1964).

An 0.620 Mev β^- branch was observed to compete with the previously reported gamma decay from the 3.14-h ^{90m}Y. The calculated values, derived from the shell model for the branching ratio $[(0.620\text{ Mev }\beta^-)/(0.482\text{-Mev }\gamma) = 1.16 \times 10^{-3}]$ and the log ft (7.54) are compared with the experimental values of $3.8 \pm 1 \times 10^{-3}$ and 7.04 ± 0.13, respectively. The small discrepancy is probably due to impurities in the shell-model configurations assumed for the transition. (auth)

36669 PROPERTIES OF THE SECOND VIBRATIONAL LEVEL IN Te^{124}. Michael J. Glaubman and J. David Oberholtzer (Northeastern Univ., Boston). Phys. Rev., 135: B1313-16(Sept. 21, 1964).

The $\beta\gamma$–γ coincidences in the decay of ^{124}Sb were studied in order to determine the angular correlations in the γ–γ cascades from the two states of the second vibrational level in ^{124}Te, and to determine the relative intensities of the beta transitions to these states. It is concluded that the state at 1.248 Mev has spin 4 and the one at 1.326 Mev has spin 2, that the 2-2 transition is 94% quadrupole ($\delta = 4.1 \pm 0.6$), and that the intensity of the beta transition to the spin-4 state is 5/9 (±15%) of that to the spin-2 state. (auth)

36670 Be^9 STATES FROM THE REACTION $Li^6(Li^7,\alpha)\cdot Be^9$. R. A. Mendelson, Jr., E. Norbeck, and R. R. Carlson (Univ. of Iowa, Iowa City). Phys. Rev., 135: B1319-22 (Sept. 21, 1964).

^6Li and ^7Li ions accelerated to energies between 2.15 and 3.0 Mev were used to study the reaction $^6Li(^7Li,\alpha)^9Be$. Alpha particles were distinguished from other reaction products by a dE/dX-E system based upon a general-purpose digital computer. States were observed at 0.00, 1.75, 2.43, 3.04, and 11.9 Mev excitation in ^9Be in the presence of a very prominent continuum. The width of the 11.9 ± 0.2-Mev state was measured at 500 ± 100 kev. No other states up to an upper limit of 13.0-Mev excitation could be observed above the continuum. The yield of the 2.43-Mev state at 0° was found to have an energy dependence different from the ground and 3.04-Mev states. Angular distributions of the ground-state alpha particles obtained at ^6Li bombarding energies of 2.2 and 3.0 Mev were observed to be slightly energy-dependent. (auth)

36671 LIMITED APPLICABILITY OF THE THEORY OF NUCLEON TUNNELING. G. Breit (Yale Univ., New Haven). Phys. Rev., 135: B1323-37(Sept. 21, 1964). (NYO-1807-11)

The assumptions made in the theory of the tunneling process of single-nucleon transfer are reviewed and their shortcomings discussed. A schematic form of a black-box treatment is systematized and assumptions made are pointed out. The reason for the agreement between results obtainable from this form and the earlier way of ascertaining quantum-mechanical corrections is discussed. Among the assumptions made is the legitimacy of neglecting terms that vanish when the ratio of the nucleon mass to the re-

duced mass is set equal to zero. The character of effects arising from these terms is illustrated by means of a one-dimensional model, and the associated inadequacy of dealing only with the relative motion of the heavy aggregates without including effects of motion with respect to the inertial system is pointed out. Further discussion concerns itself with the effects of the angular momentum of the transferred nucleon in the emitting nucleus and in the receiving one on the space dependence of the transfer function; the symmetrized forms of the transfer cross section; the effect of the relative velocity of the emitter and receiver nuclei on the matching of the angular momentum of the nucleon; the transition from the isotropic-transfer quantum treatment to the corresponding semiclassical one, including the double-limit situation involved in making the scattering angle and the space-decay parameter approach zero; the questions involved in the consideration of the exterior region, including the possible effect of deuteron, triton, alpha particle, and other types of tentacles in configuration space; and the distinction between the nucleon configuration and wave-function assignments of shell-structure theory and the nucleon configurations and wave functions that matter more directly for the treatment of the exterior region and of single-nucleon transfer. The bearing of virtual Coulomb-excitation processes on applications of usual potential-barrier penetrability estimates for reaction-yield estimates made in astrophysics is mentioned, and it is pointed out that as the kinetic energy is decreased, the nuclear radii in ordinary estimates must be increased. (auth)

36672 FISSION DYNAMICS AND THE STATISTICAL THEORY. Peter Fong (Cornell Univ., Ithaca, N. Y.). Phys. Rev., 135: B1338-9(Sept. 21, 1964).

A posteriori justification of the statistical theory of nuclear fission is found in the shell effect on mass distribution and kinetic-energy distribution as well as in the constancy of kinetic energy at high-energy fission. A priori justification is found in the calculation showing that the scission time is longer than the characteristic nuclear time and the nuclear relaxation time. It is shown that the condition for the adiabatic approximation to be valid cannot be satisfied in the fission process from the saddle point to scission and therefore the validity of the adiabatic theory of fission is in doubt. (auth)

36673 CROSS SECTIONS AND ISOMER RATIOS FOR THE $K^{41}(\alpha,n)Sc^{44m,44g}$ REACTION. Clyde Riley, Kaoru Ueno, and Bruno Linder (Florida State Univ., Tallahassee). Phys. Rev., 135: B1340-4(Sept. 21, 1964).

The absolute cross sections for ^{44m}Sc and ^{44g}Sc were determined at 1-Mev intervals from 8 to 19 Mev. The experimentally determined isomer-ratio function was compared with the theoretical predictions of a Huizenga-and-Vandenbosch-type calculation. A value of 1.7–1.8 for σ, the spin cutoff parameter, was found to give a good fit of the experimental isomer ratios below the $(\alpha,2n)$ threshold. Deviations of the calculated values from the experimental values above this threshold were interpreted to be the result of considerable spin fractionation. (auth)

36674 LEVELS IN N^{16} FROM THE TOTAL NEUTRON CROSS SECTION OF N^{15}. D. B. Fossan, R. A. Chalmers, L. F. Chase, Jr., and S. R. Salisbury (Lockheed Aircraft Corp., Palo Alto, Calif.). Phys. Rev., 135: B1347-51 (Sept. 21, 1964).

The total neutron cross section of ^{15}N was measured for energies from 0.45 to 2.20 Mev. Neutrons with energy spreads between 15 and 30 kev were produced by the ^{7}Li(p,n)^{7}Be or T(p,n)^{3}He reaction with protons from a Van de Graaff accelerator. Resonances were observed in the total cross section at laboratory energies of 0.93, 1.11, 1.57, 1.92, and 2.02 Mev with widths of 30, 20, ≤10, ≤15, and 55 kev, respectively. The excitation energies, spins, and parities for the corresponding ^{16}N levels deduced from this experiment are, respectively, 3.37, 1^+; 3.54, (0^+); 3.97, (1^-); 4.30 (1^+); and 4.39, 1^-; where the energies are in Mev. (auth)

36675 THE MULTIPLE COULOMB EXCITATION OF A NON-AXIAL ROTATOR. V. V. Pashkevich. Vestn. Mosk. Univ., Ser. III, Fiz. Astron., No. 6, 65-76(Nov.-Dec. 1963). (In Russian)

The Alder-Winther method was used for determining Coulomb excitations of even-even nuclei described by a strong nonaxial Davydov-Filippov rotator. Excitation cross sections, symmetry properties, and the integral for determining the cross sections are discussed. Excitation probabilities were calculated for spin levels 2, 2′, 4, 4′, and 6. (R.V.J.)

36676 A STUDY OF ELECTRON-PHOTON SHOWERS IN IRON. V. S. Murzin and I. D. Rapoport (Moscow State Univ.). Zh. Eksperim. i Teor. Fiz., 47: 3-6(July 1964). (In Russian)

The shape of electron-photon cascades in iron was measured with an ionization calorimeter for primary electron and photon energies of about 2×10^{11} ev. The shape found agrees with the theoretical one if the cascade unit is taken to be equal 14.1 g/cm^2. (auth)

36677 RESONANCE SCATTERING OF γ QUANTA ON As^{75}, Sb^{123} AND Re^{187} NUCLEI. Yu. K. Shubnyi, D. K. Kaipov, and R. B. Begzhanov (Inst. of Nuclear Physics, Academy of Sciences, Kazakh SSR and Inst. of Nuclear Physics, Academy of Sciences, Uzbek SSR). Zh. Eksperim. i Teor. Fiz., 47: 16-20(July 1964). (In Russian)

Resonance scattering of γ quanta on ^{75}As, ^{123}Sb, and ^{187}Re nuclei was investigated by employing ^{75}Ge, ^{123}Sn, and ^{187}W sources. The following values for the lifetimes of the excited states were obtained: τ_γ (M1) 0.265-Mev level of ^{75}As = $(1.7 \pm 0.3) \times 10^{-11}$ sec τ_γ (M1) 0.161-Mev level of ^{123}Sb = $(8.9 \pm 3.0) \times 10^{-10}$ sec, τ_γ (E1) 0.686-Mev level of ^{187}Re = $(4.1 \pm 2.0) \times 10^{-10}$ sec. (auth)

36678 PHOTODISINTEGRATION OF He^3. A. T. Varfolomeev and A. N. Gorbunov (Lebedev Inst. of Physics, Moscow). Zh. Eksperim. i Teor. Fiz., 47: 30-9(July 1964). (In Russian)

Photodisintegration of ^{3}He was investigated with a cloud chamber in a magnetic field at a maximum γ bremsstrahlung energy E_{max} = 170 Mev. In sharp contradiction to the theory in which interaction of particles in the final state is not taken into account, the ratio of the two to three particle disintegration yields for ^{3}He were found to equal one. The effective cross section for two-particle photodisintegration is measured. It has a broad maximum at 12-13 Mev, the value of the cross section at the maximum being ~1 mb. The integral cross section is 26.5 ± 1.3 Mev · mb. The integral cross section for photon absorption by the ^{3}He nucleus, weighed over the bremsstrahlung spectrum is 2.68 ± 0.1 mb. The mean square ^{3}He nuclear charge distribution radius (for point nucleons) is 1.60 ± 0.07 f. When the finite size of the proton is taken into account the mean square charge distribution radius is 1.79 ± 0.07 f which is in satisfactory agreement with results obtained in experiments on scattering of high energy electrons. The proton angular distribution in the cms was investigated. (auth)

36679 INTERRELATION BETWEEN THE 23.8-kev ISOMER SHIFTS OF THE Sn^{119} NUCLEAR γ TRANSITION IN METALLIC RIGID SOLUTIONS AND THE DYNAMIC PROPERTIES OF THE MATRIX. V. A. Bryukhanov, N. N. Delyagin, and V. S. Shpinel (Moscow State Univ.). Zh. Eksperim. i Teor. Fiz., 47: 80-3(July 1964). (In Russian)

The 23.8-kev isomer shift of the γ transition of the ^{119}Sn nucleus introduced as an admixture into various metallic matrices are measured. A simple and unique relation between the electron density on the nucleus of the admixture atom and the dynamic characteristics of the matrix is established. A possible qualitative interpretation of the relation is discussed. (auth)

36680 ENERGY DEPENDENCE OF NEUTRON POLARIZATION IN THE D(d,n)He^3 REACTION. I. I. Bondarenko and P. S. Otstavnov. Zh. Eksperim. i Teor. Fiz., 47: 97-9(July 1964). (In Russian)

The polarization of neutrons from the D(d,n)^{3}He reaction is measured for an emission angle of 40°. The deuteron energy is 3 Mev. The results obtained are in good agreement with the data of Dabbeldam and Walter and do not confirm the experimental results of Backer and Jones. (auth)

36681 CONTRIBUTION TO THE THEORY OF ANGULAR CORRELATION OF INTERNAL CONVERSION ELECTRONS. V. F. Boldyshev (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zh. Eksperim. i Teor. Fiz., 47: 113-15(July 1964). (In Russian)

An expression is obtained for the conversion parameters defining the angular correlation of internal conversion electrons. Approximate Furry-Sommerfeld-Maue electron wave functions are employed. (auth)

36682 ELASTIC SCATTERING OF NEUTRONS AND THE MÖSSBAUER EFFECT IN SYSTEMS WITH LOCAL DEGREES OF FREEDOM. M. V. Kazarnovskii and A. V. Stepanov (Lebedev Inst. of Physics, Moscow). Zh. Eksperim. i Teor. Fiz., 47: 139-46(July 1964). (In Russian)

Some possibilities of investigation of the lifetime and law motion with respect to local degrees of freedom of atomic system are discussed from the standpoint of experiments on quasielastic incoherent scattering of slow neutrons and on the Mössbauer effect. It is shown in particular that under conditions of poor resolution the dependance of the probabilities of these effects on the transferred momentum and on the temperature of the medium significantly differs from those for systems not possessing local states. Thus at high momenta even an increase of the probability with temperature may be observed. (auth)

36683 EQUILIBRIUM SHAPE OF ATOMIC NUCLEI. Yu. K. Khokhlov (Lebedev Inst. of Physics, Moscow). Zh. Eksperim. i Teor. Fiz., 47: 175-80(July 1964). (In Russian)

A system of nucleons in the potential of an anisotropic harmonic oscillator is considered, interaction between the nucleons being assumed due to pairing forces. The energy of such a model as a function of deformation of the potential is calculated. The case when the energy minimum is in the region of large non-axial deformations is studied. The existence of the minimum and its position are found to be practically independent of the magnitude of the pairing interaction. (auth)

36684 ENERGY OF QUADRUPOLE STATES OF STRONGLY DEFORMED EVEN-EVEN NUCLEI. Yuan Liu, V. G. Solov'ev, and A. A. Korneichuk (Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Eksperim. i Teor. Fiz., 47: 252-61(July 1964). (In Russian)

Energies of the β- and γ-vibrational states of even-even strongly deformed nuclei for $152 \leq A \leq 186$ and $228 \leq A \leq 254$ are calculated. Satisfactory agreement between the calculations and corresponding experimental data is found in the case when $\kappa_n = \kappa_p = \kappa_{np} \equiv \kappa$ where $\kappa = 10\ A^{-5/3}\ \hbar\omega_0^0$ in the first region and $\kappa = 12\ A^{-5/3}\ \hbar\omega_0^0$ in the second. In agreement with the experimental data it is shown that for the Dy and Er isotopes the energies of the γ-vibrational states lie below those of the β-vibrational states. It is noted that in most cases the lowest states with $K\pi = 2^+$ and $K\pi = 0^+$ possess distinct collective properties and their energies are much below those of the nearest poles in the secular equations. In a number of cases the energies of the quadrupole states lie near the poles and their wave functions are very close to the two-particle ones. The calculated E2 transition probabilities do not contradict the experimental data. (auth)

36685 ON ORIENTATION OF NUCLEI. M. F. Deigen and A. B. Roitsin (Inst. of Semiconductors, Academy of Sciences, Ukrainian SSR). Zh. Eksperim. i Teor. Fiz., 47: 294-5(July 1964). (In Russian)

The possibility of additional nuclear transitions in double electron-nuclear resonance produced by the electric component of a radio frequency field is considered. A system of nuclei with a preferred spin orientation can be obtained by the method. (auth)

36686 THE DECAY SCHEME OF THE 10.43 Mev LEVEL IN N^{14}. F. Riess. Thesis, Freiburg i. B., Universität, 1963. 62p. $2.00(Gmelin, AED-DISS. 63-369). (In German)

The 3.11-Mev resonance of the $^{13}C(p,\gamma)^{14}N$ reaction was used for the determination of the decay scheme of the 10.43-Mev level in ^{14}N. A 3-crystal pair spectrometer was used. A decay branch to the 7.02 Mev level with an intensity of 8% was observed. A weak transition to 5.10 Mev has an intensity of 2%. (Gmelin Inst.)

36687 RESONANCE AND NONRESONANCE RADIATION CAPTURE OF PROTONS BY C^{13} FOR PROTON ENERGIES BETWEEN 2.75 AND 3.00 Mev. W. Trost. Thesis, Freiburg i. B., Universität, 1963. 46p. $2.00(Gmelin, AED-DISS. 63-372). (In German)

The resonance level of the reaction $^{13}C(p,\gamma)^{14}N$ for a proton energy of 2.9 Mev decays primarily to the 2.31-Mev level. The cross section for this decay is 36 μb, the gamma width is 85 kev. Spin and parity of the level are deduced from the angular distribution. Cross sections for nonresonance capture for excitation energies of 4.91, 5.10, and 5.69 Mev in ^{14}N are given. (Gmelin Inst.)

36688 SELECTED TOPICS IN NUCLEAR SPECTROSCOPY. Proceedings of the NUFFIC International Summer Course in Science at Nijenrode Castele, The Netherlands, July 30—August 17, 1963. B. J. Verhaar, comp. New York, John Wiley and Sons, 1964. 355p. $12.50.

Separate abstracts were prepared for the sixteen papers included. (D.C.W.)

For abstracts of individual papers see: 36362, 36689, 36690, 36691, 36692, 36693, 36694, 36695, 36696, 36697, 36698, 36699, 36700, 36701, 36702, and 36703.

36689 NUCLEAR PROPERTIES IN ELECTROMAGNETIC AND WEAK DECAYS. H. A. Weidenmueller (Universität, Heidelberg). p.1-50 of "Selected Topics in Nuclear Spectroscopy." New York, John Wiley and Sons, 1964.

The properties of nuclei are investigated in the single-particle shell model, with particular emphasis on the gamma transition probabilities. Electromagnetic moments, spins, and parities are also considered. Theory for allowed and forbidden beta decays is presented, starting from V-A theory. Some tests of the conserved vector current vector hypothesis are then discussed. (D.C.W.)

36690 COLLECTIVE MODELS. K. T. Hecht (Univ. of Michigan, Ann Arbor). p.51-105 of "Selected Topics in Nuclear Spectroscopy." New York, John Wiley and Sons, 1964.

Nuclear models (phenomenological) are discussed in which the deviations of the average nuclear field from spherical symmetry are introduced empirically. The development of collective effects in the framework of the shell model in nuclei in which the deformed field effects arising from the long-range or low-multipole part of the N-N interaction override the short-range part or the pairing correlation effects is then considered. (D.C.W.)

36691 ENERGY CALCULATIONS IN THE NUCLEAR SHELL MODEL. I. Talmi (Weizmann Inst. of Science, Rehovoth, Israel). p.106-32 of "Selected Topics in Nuclear Spectroscopy." New York, John Wiley and Sons, 1964.

Nuclear energies are calculated using the shell model and effective two-body interactions. Calculated binding energies for 1 $f_{\frac{7}{2}}$ configurations are compared with experimental values; and level spacings, particularly for $d_{\frac{5}{2}}$ configurations, are compared with experimental observations. (D.C.W.)

36692 INTRINSIC EXCITATIONS OF NUCLEI WITH STABLE EQUILIBRIUM DEFORMATION. C. J. Gallagher (Columbia Univ., New York). p.133-98 of "Selected Topics in Nuclear Spectroscopy." New York, John Wiley and Sons, 1964.

The development of models for deformed nuclei is briefly reviewed, with emphasis on the handling of collective and intrinsic states. The predictions of the various models are compared with experimental observations. 154 references. (D.C.W.)

36693 FUNDAMENTALS OF β-DECAY THEORY. R. J. Blin-Stoyle (Univ. of Sussex, Eng.). p.199-212 of "Selected Topics in Nuclear Spectroscopy." New York, John Wiley and Sons, 1964.

The beta decay interaction is considered in terms of two vector currents with axial and polar parts. Experimental values for the axial and polar vector coupling constants are given. A discrepancy of about 2% between the polar vector coupling constant and the coupling constant for meson (μ) decay is noted, and possible explanations are considered. The conserved vector current theory is summarized, together with predictions and tests of the theory. (D.C.W.)

36694 CHARGE DEPENDENT EFFECTS IN THE NUCLEUS. R. J. Blin-Stoyle (Univ. of Sussex, Eng.). p.213-25 of "Selected Topics in Nuclear Spectroscopy." New York, John Wiley and Sons, 1964.

Charge dependence of the specifically nuclear forces was investigated by comparing theoretical predictions for the energy levels and beta decays of A = 14 nuclei and for $\Delta T = \pm 1$ allowed Fermi transitions with experimental observations. Evidence for charge dependence was noted in previous observations on N-N scattering. (D.C.W.)

36695 NUCLEAR MAGNETIC MOMENTS. R. J. Blin-Stoyle (Univ. of Sussex, Eng.). p.226-35 of "Selected Topics in Nuclear Spectroscopy." New York, John Wiley and Sons, 1964.

The form of the magnetic moment operator is considered, and the extent to which the magnetic moments of simple nuclei can be described in terms of a one-body spin-orbit force is investigated. An isobaric-spin formulation of the one-body magnetic moment operator is presented, and experimental and theoretical moments for selected nuclei are compared. (D.C.W.)

36696 SPINS OF LOW-ENERGY NEUTRON RESONANCES. H. Postma (Brookhaven National Lab., Upton, N. Y.). p.236-45 of "Selected Topics in Nuclear Spectroscopy." New York, John Wiley and Sons, 1964.

Relations for the transmission of polarized neutrons through targets of polarized nuclei are derived, particularly for the difference between the two transmissions for parallel and antiparallel neutron and nuclear spins. A BNL transmission experiment in which the spins of some rare earth resonances were determined is summarized. (D.C.W.)

36697 SHELL MODEL CALCULATIONS OF ENERGY LEVELS FOR NUCLEI IN THE REGION $28 < A \leq 40$. P. W. M. Glaudemans (Rijksuniversitet, Utrecht). p.246-54 of "Selected Topics in Nuclear Spectroscopy." New York, John Wiley and Sons, 1964.

The energy levels were calculated assuming two-body interaction and closed $d_{\frac{5}{2}}$ and inner shells and considering only configurations in which particles outside the core are in the 2 $s_{\frac{1}{2}}$ or 1 $d_{\frac{3}{2}}$ shell. For the lower levels, the results are in good agreement with experiment. The calculation is outlined. (D.C.W.)

36698 THE OPTICAL MODEL OF ELASTIC SCATTERING. P. E. Hodgson (Nuclear Physics Lab., Oxford). p.255-75 of "Selected Topics in Nuclear Spectroscopy." New York, John Wiley and Sons, 1964.

The understanding of optical potentials is surveyed, with particular attention on the extent to which the potentials can be represented by simple formulas as a function of energy, mass, and charge. Analyses of deuteron, neutron, proton, triton, ^{3}He, and alpha elastic scattering are considered. Quasi-elastic scattering is mentioned. (D.C.W.)

36699 DIRECT REACTIONS AND INELASTIC SCATTERING. P. E. Hodgson (Nuclear Physics Lab., Oxford). p.276-300 of "Selected Topics in Nuclear Spectroscopy." New York, John Wiley and Sons, 1964.

Theories for analyzing pickup and stripping reactions and inelastic scattering are reviewed, with emphasis on the nuclear structure information that can be obtained. The calculation of possible compound nuclear contributions is also outlined. Analytical results are compared with experimental data. (D.C.W.)

36700 44 Mev α INELASTIC SCATTERING BY MEDIUM WEIGHT NUCLEI. J. Saudinos (CEN, Saclay, France). p.301-16 of "Selected Topics in Nuclear Spectroscopy." New York, John Wiley and Sons, 1964.

Absolute cross sections and angular distributions for the inelastic scattering of 44-Mev alpha particles by ^{40}Ca and ^{48}Ti and by Fe, Ni, Cu, and Zn isotopes were measured. The data were analyzed by the adiabatic approximation and distorted-wave Born approximation. Second-order calculations were required for some low excited levels. (D.C.W.)

36701 ANALYSIS OF SOME FIRST FORBIDDEN BETA TRANSITIONS AND THE CONSERVED VECTOR CURRENT THEORY OF WEAK INTERACTION. J. Deutsch (Centre de Physique Nucléaire, Heverlé-Louvain, Belg.). p.323-30 of "Selected Topics in Nuclear Spectroscopy." New York, John Wiley and Sons, 1964.

Theory for testing the CVC hypothesis by first-forbidden beta transitions is summarized, together with the results of analyses of such transitions in ^{210}Bi, ^{170}Tm, ^{186}Re, and ^{188}Re. Nuclear matrix elements obtained by analyzing the decay data for ^{170}Tm, ^{186}Re, and ^{188}Re under CVC are given; and the implications of the elements for nuclear structure are indicated. (D.C.W.)

36702 SECOND FORBIDDEN BETA DECAY AND THE GROUND STATE TRANSITIONS OF Cl^{36} AND Cs^{137}. P. Lipnik (Centre de Physique Nucléaire, Heverlé-Louvain, Belg.). p.331-5 of "Selected Topics in Nuclear Spectroscopy." New York, John Wiley and Sons, 1964.

Formulas for the spectrum shape factor and the longitudinal polarization of electrons were derived in the Konopinski-Uhlenbeck approximation. The ground-state beta transitions of ^{36}Cl and ^{137}Cs were analyzed by the shape factor relation and a defined parameter. (D.C.W.)

36703 THE INDUCED PSEUDOSCALAR INTERACTION IN MUON CAPTURE AND NUCLEAR STRUCTURE. H. A. Tolhoek (Rijksuniversitet, Groningen, Netherlands). p.336-48 of "Selected Topics in Nuclear Spectroscopy." New York, John Wiley and Sons, 1964.

It is shown that the induced pseudoscalar coupling constant in muon capture can be determined, assuming the CVC hypothesis. Determination of the constant from the partial transition rates for muon capture by ^{16}O and from radiative muon capture is discussed. (D.C.W.)

Plasma Physics and Thermonuclear Processes

Refer also to abstract 36247.

36704 (AD-434097) THE EFFECTS OF MAGNETIC FIELDS ON A FLOWING PLASMA. Final Report, June 1959–November 1962. S. A. Gordon (Aerochem Research Labs., Inc., Princeton, N. J.). Contract AF33(616)-6717. 32p.

A review is made of work undertaken to measure heat transfer rates in a flowing plasma. It is pointed out that the lack of reliable measurement techniques (itself owing to the immature state of plasma research) impedes progress. The status of investigations is that a measurable decrease in heat transfer to the stagnation point has been obtained. (auth)

36705 (AFCRL-63-943) OBLIQUE INCIDENCE ON GENERAL MAGNETOPLASMA SLAB. H. Unz (Ohio State Univ. Research Foundation, Columbus). Oct. 15, 1963. Contract AF19(604)-7270. 18p. (AD-431888).

The problem of an arbitrary plane electromagnetic wave in free space, obliquely incident on a general magnetoplasma slab, is solved. The electromagnetic fields, inside and outside the plasma slab, are evaluated in terms of determinants, and the reflection and the transmission coefficients are found. (auth)

36706 (AFCRL-64-242) PLASMA DIAGNOSIS BY MEANS OF PHOTON-ELECTRON SCATTERING. Scientific Report No. 6. S. E. Schwarz (California Inst. of Tech., Pasadena). Feb. 1, 1964. Contract AF19(604)-8052. 24p. (AD-437790)

A summary of photon-electron scattering experiments is presented, and comments are made regarding their application to plasma diagnostics. The general field of gas-discharge afterglow studies is reviewed, and a summary of recent experimental studies of helium afterglow is presented. A photon-electron scattering apparatus was used to perform experiments indicating the feasibility of afterglow studies using the Thomson scattering method. An impure helium discharge afterglow having properties that make it difficult to diagnose by other means was studied using laser scattering. The afterglow was also examined spectroscopically, and the results are compared. Unexpected phenomena, which have been called induced luminosity and giant scattering, were observed. The former is superficially like the radiation enhancement reported by Rose, Lidsky, and Thompson, but there are substantial differences. The observed effects appear to arise from hydrocarbon impurities in the gas. (auth)

36707 (AFCRL-64-254) FEASIBILITY DEMONSTRATION OF A NEW PLASMA DIAGNOSTIC PROBE. Final Report. D. Kingsland (General Electric Co., Syracuse, N. Y.). Mar. 27, 1964. Contract AF19(628)-2378. 57p. (AD-435677)

The feasibility of utilizing the Thomson-scattered radiation of a ruby laser to determine electron temperature and density in a helium plasma is demonstrated. A thyratron tube was modified to create the plasma and a spectrometer was used to observe the Doppler profile of the Thomson-scattered radiation. Langmuir-type probes built into the modified thyratron were used as an independent check on electron density and temperature. There was little correlation between the laser scattering and the check provided by the Langmuir probes. A precise determination of electron temperature was not realized using the laser scattering data. An electron density of approximately 10^{15} per cubic centimeter was, however, deduced from the magnitude of the scattered energy. Opposed to this was a value, approximately 6×10^{12} per cubic centimeter, derived from the Langmuir probe data. Theoretical effort supports the laser scattering data and negates the validity of the Langmuir probe data. From this it is inferred that this diagnostic technique is sound even though the results do not completely demonstrate feasibility. (auth)

36708 (AFCRL-64-277) DIFFUSION OF PLASMAS ACROSS A MAGNETIC FIELD. Final Report, March 1, 1963–February 28, 1964. Behram Kursunoglu (Miami, Fla. Univ., Coral Gables). Contract AF19(628)-2844. 36p. (AD-436197)

Experimental investigation of transport processes in cesium-arc plasmas shows classical ambipolar diffusion across low magnetic fields, convective transport associated with the helical instability at intermediate fields, and a return, apparently to diffusive transport and relatively good confinement, at magnetic fields ten to twenty times the critical field for the onset of the instability. Improved confinement is also achieved by using a hysteresis in the parameter space of the plasma operation. The methods of Brownian motion are used to describe the diffusion of electrons and ions in a plasma across a magnetic field in the presence of an anisotropic dynamical friction. The bivariate distribution function of a plasma in a magnetic field, and the partial differential equation which it satisfies, are found. The distribution function is used to calculate the diffusion coefficients. (auth)

36709 (AFCRL-64-293) A MAGNETIC COMPRESSION EXPERIMENT FOR THE STUDY OF SHOCK WAVE STRUCTURES. Scientific Report No. 2. G. Goldenbaum and E. K. Hintz (Maryland. Univ., College Park). Dec. 1963. Contract AF19(628)-269. 22p. (AD-437941)

The construction of the experimental apparatus for the investigation of the structure of hydromagnetic shock waves was completed. By means of a technique developed in connection with so-called theta-pinch experiments, a cylindrical plasma is produced with an internal magnetic field of variable magnitude. A fast rising external magnetic field is applied, which drives the plasma towards the axis thereby generating cylindrical shock waves. The density and the composition of the initial plasma, the magnitude of the internal magnetic field, and the rise-time and the maximum amplitude of the compressing field can be varied over a wide range. In particular it is possible to choose the parameters so that the ion mean free path in the shocked plasma is large compared to the ion cyclotron radius. (auth)

36710 (AFOSR-64-0301) HYDROMAGNETIC PLASMA RESEARCH. Second Annual Report, October 1, 1962–1963. (Columbia Univ., New York). 5p. (AD-434514)

An experimental study of the ionization produced in room-temperature H_2 by electromagnetically-driven shock waves is reported. The theory of propagation of these waves in the H_2 gas is also discussed. (T.F.H.)

36711 (AFOSR-64-0353) THE LANGMUIR PROBE IN A COLLISIONLESS PLASMA. Report 681. S. H. Lam (Princeton Univ., N. J.). Mar. 1964. 69p. (AD-434842)

An asymptotic analysis of the Langmuir probe problem in a quiescent, collisionless plasma in the limit of large body dimension-to-Debye length ratio is presented. The structures of the electric potential distribution about spheres and cylinders are analyzed and discussed in detail. It is shown that when the probe potential is smaller than approximately $\frac{1}{2}KT$, where T is the undisturbed temperature of the repelled particles, there exists no sheath adjacent to the solid surface. At large body potentials, for which a sheath is present, the electric potential distribution is given in terms of several universal functions. Master current-voltage characteristic diagrams are given, which exhibit clearly the effects of all the pertinent parameters in the problem. An explicit trapped-ion criterion is presented. The general problem with an arbitrary body dimension-to-Debye length ratio is qualitatively discussed. (auth)

36712 (ARL-63-54) ENERGY ADDITION TO A FLOWING GAS BY HIGH-REPETITION-RATE, ARRESTED-BREAKDOWN DISCHARGES. H. C. Early and F. J. Martin (Michigan. Univ., Ann Arbor). Jan. 1963. Contract AF 33(616)-7243. 57p. (AD-437270)

When a steep-front impulse voltage is applied to a pair of corona-type electrodes, a current of several thousand amperes will flow through the gas for a period of 10^{-8} to 10^{-7} seconds before spark streamer formation takes place. If the voltage is removed quickly enough and the duration of current flow is short, several joules of energy can be delivered to an atmospheric-density gas in a single suppressed-breakdown pulse. Using pulse repetition rates of several thousand per second, several kilowatts of electrical power can be delivered to a subsonic or supersonic gas stream by a single set of electrodes. Compared to arc-heating methods, the pulsed-corona discharge is diffuse and uniform, and the gas flow remains much more homogeneous. The process may be useful for MHD and other research requiring a nonequilibrium gas having substantial ionization and conductivity at room temperature. (auth)

36713 (IPPJ-25) ANOMALOUS MICROWAVE RADIATION AT CYCLOTRON RESONANCE IN PARTIALLY IONIZED PLASMAS. Shigetoshi Tanaka, Hiroshi Kubo, and Kenji Mitani (Nagoya, Japan. Univ. Inst. of Plasma Physics). Mar. 1964. 29p.

The anomalous microwave radiation at cyclotron resonance in partially ionized plasma, which was reported previously, is investigated. It is shown that the radiation is not stationary in time, but is emitted pulsively at some definite phase of the low-frequency oscillation, which is present in d-c discharge plasma. The peak power of its pulsed emission is extremely large and the power obtained is larger by 2×10^4 times than that of the blackbody. Further, such a radiation can be observed at the cathode side plasma, but can not at the anode side. A large increment in intensity of this radiation or a corresponding intense absorption is not observed, when an external microwave power is fed to the plasma. The absorption coefficient corresponding to the anomalous radiation seems to be positive, and its amplitude is very small though this radiation is extremely large. It cannot be concluded from the present experiments whether the absorption coefficient corresponding to this radiation is negative or positive. (auth)

36714 (MATT-250) MEASUREMENT OF PLASMA PRESSURE AND TEMPERATURE. A. F. Kuckes (Princeton Univ., N. J. Plasma Physics Lab.). Jan. 1964. Contract AT(30-1)-1238. 10p.

The use of inductive coupling between two loops that encircle a plasma confined in a magnetic mirror for plasma pressure measurements is discussed for plasma pressure measurements is discussed for plasma subject to a magnetic perturbation. Electron temperature measurements using acoustic waves generated by the plasma ions when pulsed by the external loop are described. (R.E.U.)

36715 (NAVWEPS-8132) MAGNETOHYDRODYNAMIC THEORY OF DEFLAGRATION AND DETONATION. H. S. Green (Naval Ordnance Test Station. Underwater Ordnance Dept., Inyokern (China Lake), Calif.). Mar. 1964. 12p. (NOTS-TP-3224; AD-434569)

An analysis is presented of the influence of ionization on the processes accompanying deflagration and detonation. Under suitable conditions, ionization can be effected by the presence of impurities, increase in temperature, friction and turbulence, increase in static presence, ultrasonic and shock waves, and electromagnetic waves and radiations. In combustion and explosion most of these effects will be present, but the shock and electromagnetic waves, which propagate faster than the rest, will be of prime importance. The electromagnetic wave is technically a magnetohydrodynamic wave. Properties of these waves are discussed in the rigorous ionic theory and the effect of ionic relaxation phenomena is described. (auth)

36716 (NP-14209) HALL EFFECT IN THE MHD RAYLEIGH PROBLEM. Pau-Chang Lu (Case Inst. of Tech., Cleveland). 1964. Contract NSF-G19000. 28p.

The influence of Hall effect in the Rayleigh problem for an ionized gas at small Mach number is investigated. Advantage is taken of the small magnetic Prandtl number. The consequential neglection of the induced field is interpreted in two ways, each depicts a certain physical picture. The mathematical problem is the same for both. With the introduction of two complex functions, the problem is reduced to that without Hall effect, but with a complex conductivity. Thus, solutions can be obtained by a splitting-up into real and imaginary parts of known solutions of the MHD Rayleigh's problem without Hall effect. With possible application to the compressible counterpart in mind, an approximate solution is obtained for the

cases with small magnetic Prandtl number by a Kármán-Pohlhausen-like technique, and compared with the corresponding exact solution. (auth)

36717 (NSL-62-113-10(Pt.II)) EXPERIMENTAL AND ANALYTICAL INVESTIGATIONS OF CROSSED-FIELD PLASMA ACCELERATORS. PART II. REPORT OF ALL ANALYTIC AND EXPERIMENTAL RESULTS. P. D. Lenn, J. R. Bodoia, and S. T. Demetriades (Northrop Corp. Northrop Space Labs., Hawthorne, Calif.). May 1963. Contract AF33(657)-8558. 203p. (ASD-TDR-63-307(Pt.II); AD-433142)

Experimental and analytical investigations of the component physical phenomena and over-all operation of linear crossed-field accelerators of single and multiple electrode-pair designs are presented. Analyses and experimental measurements are given for heat transfer to accelerator components; effects of geometry, power level, pressure, magnetic field strength, and tensor conductivity on accelerator performance; and over-all operating characteristics of accelerators over a range of operating conditions. (auth)

36718 (ORNL-3113(Rev.)) ATOMIC AND MOLECULAR COLLISION CROSS SECTIONS OF INTEREST IN CONTROLLED THERMONUCLEAR RESEARCH. C. F. Barnett, J. A. Ray, and J. C. Thompson (Oak Ridge National Lab., Tenn.). Aug. 1964. Contract W-7405-eng-26. 316p.

A graphical compilation is presented of atomic and molecular cross sections of interest to controlled thermonuclear research. The present compilation is a revision of ORNL-3113, published in 1960. The cross sections are shown, as a function of energy, for collision processes involving molecular ion dissociation, charge exchange, excitation, ionization, photoionization, scattering, energy loss, secondary products, and recombination. Pertinent nuclear cross sections are also included. A bibliography is given covering the literature since 1950. (auth)

36719 (PIBMRI-1202-63) FOCUSING BY AN ANISOTROPIC PLASMA INTERFACE. Scientific Report No. 3. L. B. Felsen (Brooklyn. Polytechnic Inst. Microwave Research Inst.). Oct. 25, 1963. Contract AF19(628)-2357. 31p. (AFCRL-63-584; AD-433167)

When an electromagnetic source confined in a homogeneous, anisotropic plasma half-space radiates into the exterior medium, focusing effects may occur wherein the influence of the plane interface bounding the plasma is similar to that of an optical lens. The existence and location of the caustics and focus depends on the various plasma parameters, in particular on the strength and orientation of the externally applied magnetic field, and the refractive index curves for the medium may be used advantageously for the prediction of their properties. After a qualitative discussion pertaining to the general gyrotropic case, a detailed field evaluation for line source and dipole excitation is carried out for the special problem of uniaxial anisotropy, corresponding to an infinitely strong external magnetic field. In this instance, the ray system and the caustics may be described in simple terms and expressions are given for the fields inside or outside focusing region. (auth)

36720 (RADC-TDR-63-275) MOLECULAR STORAGE AND TRANSFER OF ELECTROMAGNETIC ENERGY IN GASEOUS PLASMAS. Final Report. T. C. Marshall, R. A. Kawcyn, E. A. McLennan, J. Berlande, and L. Goldstein (Illinois. Univ., Urbana. Engineering Experiment Station). Apr. 1964. Contract AF30(602)-2650. 114p. (AD-438419)

A laboratory study of the generation and recombination of atoms is presented. The background information consists of a discussion of various methods for producing atoms of nitrogen, oxygen, and hydrogen by electric discharges, with primary emphasis placed on the use of intense microwave electric fields. Also included is an enumeration of methods for detecting atoms. Here the emphasis is placed on the use of Electron Spin Resonance (ESR) techniques with mention made of the use of heated wire filaments and chemical titration with gases. The body of the report deals with the results of investigations into the various loss mechanisms and reactions that affect the experimental use of atoms. These losses are of three types: (a) volume recombination in the bulk of the gas; (b) surface recombinations; and (c) electronic processes in the volume of the gas. Of particular interest is the value of the surface recombination coefficients for nitrogen atoms on various substances. Measurements were made on Pyrex glass, clear fused quartz, and alumina and zirconia ceramics. In addition, the ratio of the number density of the atoms to that of the electrons was studied as a function of high-level radio-frequency energy input. (auth)

36721 (RTD-TDR-63-3130) TWO QUANTUM STATISTICAL TREATMENTS OF SPECTRAL LINE SHAPES EMITTED FROM PLASMAS. Final Report. T. Nakayama and H. E. DeWitt (Physics International Co., Berkeley, Calif.). June 1964. Contract AF29(601-5699. 63p. (AD-603003)

Two different quantum statistical approaches to the problem of determining the spectral line shape emitted from a plasma are presented. Part I is a study of hydrogenic energy levels as modified by the plasma. This is done through a perturbation expansion of the partition function of the multicomponent plasma, which gives rise to a pseudo-Schroedinger equation. The level shift and width are calculated using the random phase approximation for the dielectric function of the plasma. The results yield a small negative energy shift and a width that is proportional to n^2, where n is the principal quantum number. Part II is a formal treatment of radiative transitions between two levels in which the dipole-dipole correlation function is developed in a perturbation expansion along the lines of recent work on transport coefficients. The results yielded a line width, which agreed with a more general form given by Baranger, except for an interference term between elastic scattering amplitudes, which appeared to be a negligible contribution. (auth)

36722 (SSD-TDR-64-115) COMPARISON OF FOKKER-PLANCK AND BHATNAGAR-GROSS-KROOK EQUATIONS. M. S. Grewal (Aerospace Corp., El Segundo, Calif.). June 5, 1964. Contract AF04(695)-269. 25p. (AD-602960; TDR-269(4280-30)-2)

A Fokker-Planck equation, such as the one used in the theory of Brownian motion, and the Bhatnagar-Gross-Krook equation that conserves only number density are compared via their transition probabilities. These two equations have been used in various problems arising in the study of plasmas. It is shown that for large time intervals compared with the average collision time, both equations give the same results. For the opposite limit of small time intervals compared with the collision time, the disparity between the two equations increases as the initial velocity of the test particle increases; however, the difference between the two transition probabilities is shown to be reduced if the initial velocity distribution is Maxwellian. (auth)

36723 (TID-20892) INVESTIGATIONS OF THE HYBRID ION-ELECTRON RESONANCE. Semi-Annual Status Report No. 2, December 1, 1963–May 31, 1964. (Texas. Univ., Austin). Contract AT(40-1)-3110. 22p.

Experimental studies of the hybrid ion-electron resonance are reported. Two arrangements are used for the observations: a partially ionized discharge (in H, D, or He) generated by an r-f oscillator, which is also used for coupling studies; and a fully ionized Cs plasma generated by hot contact plates, i.e., by a power source independent of the coupling oscillator. (T.F.H.)

36724 (UCRL-7864) LOOP CURRENTS IN A SYSTEM OF INDUCTIVELY COUPLED, SEQUENTIALLY ENERGIZED AND CROW-BARRED COILS. R. E. Ellis (California. Univ., Livermore. Lawrence Radiation Lab.). May 19, 1964. Contract W-7405-eng-48. 44p.

A computer program designated M-PULSE, for use on the IBM 7090, was developed for computing the loop currents, as a function of time, in a circuit consisting of up to 14 inductively coupled loops. A loop may typically consist of a pulsed coil and its associated capacitor bank (RLC loop), or the shielding for a d-c coil (RL loop). Loops may be energized or crowbarred in sequence (when crowbarred an RLC loop becomes an RL loop). The program is specifically designed for use in calculating the currents in the pulsed coils of a plasma fusion device. (auth)

36725 DIFFRACTION BY A CONDUCTING HALF-PLANE IN AN ANISOTROPIC PLASMA. E. V. Jull (National Research Council, Ottawa). Can. J. Phys., 42: 1455-68(Aug. 1964).

The diffraction of a plane electromagnetic wave by a perfectly conducting half-plane in an anisotropic plasma is considered. The plasma is characterized by a permittivity tensor, and the wave is assumed to propagate in a direction normal to the magnetostatic field and the diffracting edge, but its angle of incidence is otherwise arbitrary. Only the H-polarized wave of the incident field, which has a single magnetic field component parallel to the edge, is affected by the anisotropy and the analysis is restricted accordingly. Representing the scattered field as an angular spectrum of plane waves leads to dual integral equations from which an expression for the scattered field is obtained. The total field is then reduced to Fresnel integrals and its far-field behavior is investigated. Agreement with Seshadri and Rajagopal's result for a wave normally incident on the conductor, which was obtained by using the Wiener-Hopf technique, is found. The differences between isotropic and anisotropic solutions to this problem, which arise from the differing boundary conditions on the tangential magnetic field, are examined. (auth)

36726 RADIATION FROM ELEMENTARY FLUID-MECHANICAL SOURCES IN AN UNBOUNDED ELECTRON PLASMA. S. R. Seshadri (Sylvania Electric Products Inc., Waltham, Mass.). Can. J. Phys., 42: 1573-86(Aug. 1964).

The radiation characteristics of a line source of fluid flux and a line source of force, embedded in a homogeneous electron plasma of infinite extent, are investigated for the case in which a uniform magnetic field is impressed externally throughout the medium in the direction of the source. It is found that there are two propagating modes which are strictly coupled longitudinal and transverse waves. However, one of the modes is predominantly transverse in the entire frequency range of propagation and the other is predominantly transverse in the lower, and predominantly longitudinal in the higher ranges of frequency of propagation. It is shown that the elementary fluid-mechanical sources considered radiate significant amounts of power only in the longitudinal-type waves. (auth)

36727 MODULATION OF ELECTROMAGNETIC WAVES BY ACOUSTIC WAVES IN A PLASMA. Mahendra Singh Sodha and Carl James Palumbo (Republic Aviation Corp., Farmingdale, N. Y.). Can. J. Phys., 42: 1635-42 (Aug. 1964).

An analysis of the modulation of an electromagnetic wave, propagating in a plasma, in which an acoustic wave is present is reported. The modulation of the transmitted and reflected waves from a plasma-free space interface was also analyzed. A discussion of the results obtained was given. (auth)

36728 THE NON-STATIONARY MAGNETO-GAS-DYNAMIC PROBLEM. A RIEMANN WAVE ANALOGUE. N. V. Saltanov and V. S. Tkalich (Kiev State Univ.). Dokl. Akad. Nauk SSSR, 156: 529-32(May 21, 1964). (In Russian)

The Maxwell and continuity equations give a full set of symmetry integrals, with whose aid the initial equations are converted to a set of two scalar equations in order to determine the total pressure and the first velocity component. After integration, the magnetic field is related to the density, particle function, and velocity. Thus, the problem is reduced to solving a set of two quasilinear equations in order to determine n (number of particles per unit of residual volume) and v [$v \equiv \Omega U_1$, where the vector U is composed of the spacial components of a four-dimensional velocity vector, and the term $\Omega \equiv (1 + U^2)^{-0.5}$]. After finding n and v, the remaining physical components can be determined. The gas dynamics equations are converted to the variables (P, ψ, θ), where P is the total pressure, ψ is a particle function, and θ is related to the velocity vector. The effective energy W as a function of P and ψ can be determined parametrically. These equations are similar to those in a previous theory on stationary motion. With a barotrophic medium, analogous results were obtained for the non-stationary problem. Riemann waves were investigated in the quasibarotrophic medium. The dependence of the Riemann invariants and the rate of propagation of a disturbance on the transverse components u of the velocity U enters through the effective energy. (TTT)

36729 ELECTRON DENSITY MEASUREMENT OF A PLASMA COLUMN BY SURFACE WAVE RESONANCES. Yasuo Akao and Yoshio Ida (Nagoya Univ., Japan). J. Appl. Phys., 35: 2565-70(Sept. 1964).

A method for determining electron density in cylindrical plasma columns uses surface wave resonances which occur when the length of plasma column is an integral multiple of the half-wavelength of the surface wave. One type of resonance is in an axially symmetric mode, the other is in a dipolar mode. A theory is given for the relation of resonance frequency to electron plasma frequency. Experiments were performed with both propagation modes excited simultaneously; the axially symmetric resonances are at much lower frequencies than the electron plasma. (auth)

36730 A GREEN'S FUNCTION METHOD FOR THE SOLUTION OF A CLASS OF TWO-DIMENSIONAL PROBLEMS INVOLVING ANISOTROPIC COMPRESSIBLE PLASMA (WITH AN APPLICATION TO THE UNBOUNDED MEDIUM). Musa Yildiz (Raytheon Co., Wayland, Mass.). J. Electron. Control (1), 16: 617-23(June 1964).

The study of the radiation characteristics from an arbitrary source by an isotropic compressible cylindrical structure is very difficult to handle in general, but if the

source is a magnetic line parallel to, or an electric line perpendicular to the external magnetic field, then the electromagnetic and plasma (acoustic) fields lead to a set of coupled partial differential equations. Coupled electro-acoustical field expressions possess an anisotropy in optical and acoustical modes and are expressed in terms of two distinct anisotropic Green's functions which satisfy the well-known two-dimensional inhomogeneous wave equations: $(\nabla_t^2 + n_{1,2}^2)G_{1,2} = -[\delta(r - r')/r]\ \delta(\phi - \phi')$, where $n_{1,2}^2$ are anisotropic radial wave numbers. A class of two-dimensional boundary value problems with the appropriate boundary conditions of the cylindrical structures in a compressible anisotropic plasma can easily be solved. By using the scalar Green's functions $G_{1,2}$ all the field expressions are evaluated in an unbounded medium for a magnetic line source. (auth)

36731 STABILITY OF A MAGNETO-PLASMA. Louis Gold (Kennecott Copper Corp., Lexington, Mass.). J. Electron. Control (1), 16: 625-31(June 1964).

The characteristic equation describing the stability of a magneto-plasma is elaborated for the planar diode configuration having an externally applied d-c magnetic field parallel to the electrode system, ignoring the role of collisions. In the limits of either cold plasma or zero magnetic field, a somewhat modified analysis is required. These reduced cases are essential to the study, both to confirm the correctness of the more general solution and to arrive at more transparent situations which can be readily interpreted. Thus the familiar result secured earlier in the absence of the magnetic field is recovered with the additional feature that at finite temperatures stable behavior demands $Jv_0/\rho_+ \geq 2$, where J is the current density, v_0 the thermal velocity and ρ_+ the mean plasma density. Behavior of the cold magneto-plasma is delineated in terms of an elementary characteristic equation that reflects the stabilizing effect of the magnetic field for lower energy operation of a plasma diode. The related transit time sheds further light on the response pattern. (auth)

36732 MEASUREMENT OF THE M/L-CAPTURE RATIO IN ^{113}Sn DECAY. C. Manduchi, G. C. Nardelli, M. T. Russo-Manduchi, and G. Zannoni (Universita, Padua and Istituto Nazionale di Fisica Nucleare, Padua). Nuovo Cimento (10), 33: 49-54(July 1, 1964).

A direct measurement of the M/L capture ratio of ^{113}Sn was made, using a multiwire proportional counter. The M/L capture ratio was determined to be 0.20 ± 0.01. (auth)

36733 SOME STUDIES OF THE SPECTROSCOPIC CHARACTERISTICS OF THE PLASMATRON. M. S. Frish and G. P. Startsev. Opt. Spectr. (USSR) (English Transl.), 16: 396-8(May 1964). Translated from Opt. i Spektroskopiya, 16: 724-8(May 1964).

The temperature and the time variation of the emission of a plasma jet in an argon stream were studied. It was found that there are concentration and temperature inhomogeneities in this type of source. It was established that the self-constricted plasma jet emerges in a uniform stream from the nozzle. (auth)

36734 THE PLASMA RESONANCE PROBE IN A MAGNETIC FIELD. F. W. Crawford and R. S. Harp (Stanford Univ., Calif.). Phys. Letters, 11: 126-7(July 15, 1964).

A theory of the plasma resonance probe in a magnetic field is presented based on an equivalent dielectric model for the probe-plasma system. (C.E.S.)

36735 CONDUCTIVITY OF A HOT ELECTRON GAS. D. F. Du Bois (Hughes Research Labs., Malibu, Calif.) and V. Gilinsky. Phys. Rev., 135: A1519-28(Sept. 14, 1964).

The dissipative part of the high-frequency wave-number-dependent conductivity tensor of a hot, dilute electron gas near equilibrium is calculated exactly to terms proportional to the plasma parameter k_D^3/n (the inverse of the number of particles in a Debye sphere), in the limit of classical statistics. The calculation includes high-frequency collective dynamic screening effects consistently to this order. These collective effects have an important effect on the frequency dependence of the conductivity for frequencies greater than about twice the electron-plasma frequency. (auth)

36736 OBSERVATIONS OF INTERACTION BETWEEN HYDROMAGNETIC WAVE AND ELECTRICAL CURRENT. Donald A. McPherson (Aerospace Corp., Los Angeles). Phys. Rev. Letters, 13: 267-9(Aug. 24, 1964).

An interaction between a hydromagnetic wave and a d-c current was observed in a linear discharge tube coaxial with a pulsed 30-kG magnetic field. The tube was filled with 75 μ of helium, and the hydromagnetic waves were generated by discharging a capacitor through a single-loop antenna at one end of the tube. The dependence of the interaction on wave polarization, frequency, current density, and conductivity was evaluated. Experimental results show good agreement with theory. (R.E.U.)

36737 OBSERVATION OF MICROWAVE RADIATION FROM PLASMA OSCILLATIONS AT THE UPPER HYBRID FREQUENCY. A. Y. Wong and A. F. Kuckes (Princeton Univ., N. J.). Phys. Rev. Letters, 13: 306-8(Aug. 31, 1964).

Radiation was observed from a highly ionized cesium plasma. The radiation measurement was carried out with a microwave-focusing lens and a radiometer. The plasma was confined by an axial field of 12 kgauss. It is shown that the hybrid resonance is accessible upon the application of a proper field gradient. This results in the conversion from longitudinal oscillations at the resonance to electromagnetic radiation which is observed. (C.E.S.)

36738 ELECTRON BEAM-PLASMA INTERACTION IN A TWT. K. R. U. Weimer and H. Bodt (Philips' Gloeilampenfabrieken, N. V., Eindhoven, Netherlands). Proc. IEEE (Inst. Elec. Electron. Engrs.), 52: 965-6(Aug. 1964).

Beam-plasma tubes with a noise figure of about 55 db and an amplification of 3 to 3.5 db/cm of interaction length were operated at 4 to 5 Bc. The tubes, resembling a TWT, were fitted with two separate helices and filled with mercury vapor. The electron beam produced plasma over the entire beam length. Power was fed through one helix and withdrawn through the other. (D.C.W.)

36739 RELATIVISTIC CORRECTIONS IN SYSTEMS OF FERMIONS. F. Sanchez-Martin and F. Lopez-Gordo (Universidad, Madrid). Rev. Univ. Ind. Santander, 6: 11-12(Mar. 1964). (In Spanish)

A theoretical discussion is given of problems involved in confining a plasma, and a study is made of relativistic corrections that are applicable for systems of fermions whose concentration is high. By consideration of a plasma of free fermions confined in a space, an expression is derived for the pressure against the walls of the chamber. When the pressure is zero, the walls may be removed, and P_0, the maximum linear momentum in the system, corresponds to a value of ~0.75 Mc. By use of another expression for P_0, its value may be solved with N/V (where N is Avogadro's number and V is volume); if the electrons in a conducting band are treated, in a material with atomic wt M, then the density of this material such that the electrons are self-confined is found to be $10^{24}m^3M$, which is of the order of 10^4 kg/dm^3. To obtain a concentration above this,

compression of the material and then a slow adiabatic expansion are required, after having surpassed the time necessary for the system to come to equilibrium, in such a way that P, the pressure, is zero. After this a rapid adiabatic expansion is performed. The atoms disappear almost entirely from the original space but the electrons remain confined in their conduction band. The final expansion corresponds to an emission of nuclei while the electronic cloud is not perturbed. The assumptions for this ideal situation are that the particles do not interact and that the system is isolated. This effect has possible applications to the confinement of a plasma in a finite space. (BBB)

36740 ON ELECTROMAGNETIC INSTABILITIES OF PLASMA. Chyuan-kong Loh (Futan Univ., Shanghai). Wu Li Hsueh Pao, 20: 289-96(Apr. 1964). (In Chinese)

A strict and general instability criterion was obtained by analyzing the geometric properties of the dispersion relation of electromagnetic waves in plasma with anisotropic velocity distribution. The criterion is applied to the cases of anisotropic temperature and current-carrying plasma. Finally, the relativistic correction of Weibel's formula was obtained. (auth)

36741 NONLINEAR INTERACTION BETWEEN PLASMA WAVES. L. M. Gorbunov and V. P. Silin (Lebedev Inst. of Physics, Moscow). Zh. Eksperim. i Teor. Fiz., 47: 200-11(July 1964). (In Russian)

Nonlinear interaction between plasma waves is considered. For the high frequency electron Langmuir oscillations of an isotropic plasma it is shown that in the first nonvanishing approximation in powers of the ratio of Debye radius to wave length, $(r_D/\lambda)^2$, a pumping-over from short to long waves occurs in the spectrum. Waves with parallel or perpendicular wave vectors do not interact in this case. Such waves are capable of interacting only in the next approximation in powers of $(r_D/\lambda)^2$. Energy attenuation of the Langmuir oscillations appears in the same approximation. A system consisting of a plasma and slow beam moving with a velocity less than that of the particle thermal velocity but greater than the ratio of the square of thermal velocity to phase velocity of the oscillations is studied, and it is shown that if the temperature of the plasma at rest is lower than that of the beam temperature, pumping will occur from high to low frequencies and the oscillation energy decreases. Conversely, when the temperature of the plasma at rest is higher than that of the beam, spectral pumping proceeds from low to high frequencies. In this case the oscillation energy increases, that is, nonlinear oscillation pumping arises. In conclusion, nonlinear interaction between short wave ion-acoustic oscillations is considered for conditions when spectral pumping is the decisive effect and also for conditions when nonlinear oscillation attenuation is the predominant effect. (auth)

36742 KINETIC PROPERTIES OF A PLASMA WITH A LARGE RADIATION PRESSURE. L. E. Gurevich and V. I. Vladimirov (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Eksperim. i Teor. Fiz., 47: 300-10(July 1964). (In Russian)

The kinetic coefficients (electric conductivity and thermal conductivity tensors) of a plasma in a magnetic field are investigated for the case of scattering of electrons on ions, photon relaxation being due to Compton scattering on electrons or to electron absorption resulting from collisions with ions. It is shown that the photon wind may create a strong electron drag effect which appreciably affects the thermal emf. It is furthermore shown that scattering of photons on electrons which they drag along (mutual drag effect) also significantly influences the kinetic properties of the plasma by changing its transverse thermal conductivity. Finally, it is shown that the familiar methods of removal of the infrared divergence must be modified in the presence of an external radiation field. (auth)

36743 A SHORT REVIEW OF FUSION STUDIES. A. E. Robson (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.509-16 of "Gas Discharges and the Electricity Supply Industry." London, Butterworths, 1962.

A brief review of fusion studies and containment geometries is given including the zeta pinch, theta pinch, hard core, stellerator, magnetic mirror, and cusp geometries. (C.E.S.)

36744 ANALYSIS OF ENERGY EXCHANGES IN A FAST TUBULAR PINCH. M. Bineau and Ch. Maisonnier (Euratom-CNEN, Frascati, Italy). p.517-28 of "Gas Discharges and the Electricity Supply Industry." London, Butterworths, 1962.

Using an initially hollow cylindrical plasma, the energy stored in a condenser bank can be efficiently transferred to a collapsing plasma column. The behavior of such a system is a function of two parameters only. For optimal values of these parameters the fluid motion is in phase with the condenser voltage, and most of the initial energy will be again found in the condenser bank at the end of the first fluid expansion. (auth)

36745 ELECTRODE EFFECTS IN LOW-PRESSURE HIGH-CURRENT DISCHARGES. L. A. King (Electrical Research Assn., Leatherhead, Surrey, Eng.). p.529-33 of "Gas Discharges and the Electricity Supply Industry." London, Butterworths, 1962.

High-energy ions were observed in the column of d-c arcs at low pressures and with axial magnetic fields, with overall voltages of the order of the ionization levels observed. The currents ranged up to about 1,000 amp. The investigation shows that the appearance of high energy ions under these discharge conditions is due to a stable high-voltage cathode mechanism and not to ionization in the column itself. (auth)

36746 SOME RESULTS OF C.E.R.L. RESEARCH ON ROTATING PLASMAS. J. S. T. Looms (Central Electricity Generating Board, Leatherhead, Surrey, Eng.). p.534-44 of "Gas Discharges and the Electricity Supply Industry." London, Butterworths, 1962.

The applicability of hydromagnetic capacitors to electric supply systems is discussed in terms of the available power-density and variable permittivity of rotating plasma dielectrics. Experimental results are presented which show that the formation of the plasma, even in zero magnetic field, is a complicated process involving the rate of rise of the charging current and that the plasma in the machine is azimuthally asymmetrical. (auth)

36747 INTERACTION BETWEEN A MOVING PLASMA AND A NEUTRAL GAS. Ulf Fahleson (Royal Inst. of Tech., Stockholm). p.545-52 of "Gas Discharges and the Electricity Supply Industry." London, Butterworths, 1962.

Experiments are described which show that the interaction between a plasma and a neutral gas increases rapidly above critical velocity. The increased interaction seems to be connected with an increased ionization rate. The mechanism for this ionization is not fully understood. (auth)

36748 MICROWAVE TECHNIQUES FOR MEASUREMENT OF TRANSIENT PLASMA PROPERTIES. M. P.

Bachynski and F. J. F. Osborne (RCA-Victor Labs., Montreal). p.553-64 of "Gas Discharges and the Electricity Supply Industry." London, Butterworths, 1962.

A study of the polarization of electromagnetic waves reflected by or transmitted through a plasma can be used as a technique for microwave diagnostics of transient plasma properties. Consideration is given to the polarization characteristics of electromagnetic waves interacting with simple bounded isotropic and anisotropic plasmas. Indications of the effect on polarization of reflection from isotropic plasmas, and of refraction into anisotropic plasmas are presented. A microwave multiple probe system and a microwave polarimeter unit are described which are suitable for measuring these effects in either transient or steady-state plasmas. (auth)

Shielding

36749 (AD-431671) COMPARISON OF EXPERIMENTAL AND THEORETICAL GAMMA RAY ALBEDO. An Interim Report. C. M. Huddleston (Naval Civil Engineering Lab., Port Hueneme, Calif.). Jan. 10, 1964. 9p. (TN-567)

A comparison is made between the results of Monte Carlo calculations and two independent experimental determinations of values for the differential dose albedo of gamma rays on concrete. The validity of a semiempirical formula for gamma-ray albedo is examined. Information is presented on the current status of our knowledge of gamma-ray albedo, and the direction of future work is indicated. (auth)

36750 (KN-63-76(R)) A FORTRAN II PROGRAM FOR THE CALCULATION OF THE TRANSPORT OF GAMMA RAYS BY THE METHOD OF MOMENTS. Richard E. Vogel (Kaman Aircraft Corp. Kaman Nuclear Div., Colorado Springs). June 1, 1963. 151p.

A review of the moment method, a description of the numerical equations, a listing of the FORTRAN II IBM 1620 program, tables of the moments for several source energies, and tables of the final dose and flux computations are presented. The method is compared with a Monte Carlo method. The photon penetration problem is treated using a point isotropic source. (R.E.U.)

REACTOR TECHNOLOGY

General

36751 (ANL-6912) REACTOR DEVELOPMENT PROGRAM. Progress Report, June 1964. (Argonne National Lab., Ill.). July 21, 1964. Contract W-31-109-eng-38. 108p.

Research is reported on: boiling water reactor operations and physics; liquid-metal-cooled reactor physics, fuel development and reprocessing, and operations; general reactor technology; development of Argonne Advanced Research Reactor and MHD conversion concepts; and nuclear safety studies. (T.F.H.)

36752 (HW-75782) REDUCTION OF THE EFFLUENT WATER RADIONUCLIDES BY ADDITION OF SODIUM SILICATE TO PROCESS WATER. D. E. Robertson and R. W. Perkins (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Dec. 10, 1962. Contract AT(45-1)-1350. 17p.

The effect of the addition of sodium silicate at 20 and 40 ppm (as SiO_2) on the effluent water radionuclides ^{24}Na, ^{31}Si, ^{32}P, ^{51}Cr, ^{56}Mn, ^{64}Cu, ^{65}Zn, ^{76}As, and ^{239}Np has been measured. The radionuclides ^{32}P, ^{51}Cr, ^{64}Cu, ^{76}As, and ^{239}Np were reduced by factors of about 2, 1.4, 1.8, 2.2, and 3.0, respectively, at 20 ppm and by factors of about 2.5, 1.4, 1.8, 3, and 2, respectively, at 40 ppm. The concentrations of ^{65}Zn and ^{51}Cr were not changed appreciably, while those of ^{24}Na and ^{31}Si were each increased by factors of 2 and 3 at 20 ppm. A part of the sodium silicate addition study involved silicate addition without neutralization and produced an increase in the process water pH from 6.6 to 7. A later test, in which the process water pH was raised from 6.6 to 7.0 and finally to 7.5 with NaOH, did not produce a decrease in any of the effluent water radionuclide concentrations. (auth

36753 (HW-80521) A NEW MODEL CONCEPT FOR LARGE NUCLEAR REACTORS. R. A. Harvey (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). June 1964. Contract AT(45-1)-1350. 22p.

Information is provided on equivalent structures of multivariable systems with application to a large nuclear reactor. The methods and considerations for interaction compensation and the development of a suitable type of an equivalent structure are included. The factors pertinent to the consideration of a model of a nuclear reactor are discussed and reasons are presented for choosing a particular model. An analog computer study that verified the expected results is presented and it is concluded that there exists a best equivalent structure for the model whose parameters can be determined from actual measurements on a reactor. The results are equally useful for steady-state optimization and for automatic control considerations. (auth)

36754 (KFK-223) REACTOR TEMPERATURE TRANSIENTS WITH SPATIAL VARIABLES. FIRST PART. RADIAL ANALYSIS. L. Caldarola (Kernforschungszentrum. Institut fur Angewandte Kernphysik, Karlsruhe, Germany) and E. G. Schlechtendahl (Kernforschungszentrum, Karlsruhe, Germany). May 1964. 57p.

Axial and radial analyses of the solutions of the heat balance equations with spatial variables are presented. In the radial analysis, heat propagation inside the cylindrical fuel element is studied. Heat transport along the coolant channel is considered in the axial analysis. (R.E.U.)

36755 CALIBRATION OF THE POWER OUTPUT OF THE CORE OF A REACTOR AS A FUNCTION OF NEUTRON FLUX. Giovanni Petrucci. Rivoluzione Ind., No. 134, 49-51(Feb. 1964). (In Italian)

A general plan for the measurement of the thermal power of a swimming-pool reactor with heat exchangers and coolants is examined. The method is based on the measurement of the power exchange at a given time after startup. The principles of the electronic device designed to make this measurement are discussed and illustrated. (J.S.R.)

36756 CHARACTERISTICS AND PROSPECTS FOR ORGANIC LIQUID NUCLEAR REACTORS. Enrico Crispino. Rivoluzione Ind., No. 137, 25-9(May 1964). (In Italian)

A review of the advantages and disadvantages of organic reactor coolant and moderator serves as an introduction to a brief discussion of the proposed design of the Italian organic reactor. The reactor and its primary and auxiliary systems are described. (J.S.R.)

Auxiliaries and Components

Refer also to abstract 36048.

36757 (ACNP-64584) DECYGAD: A FORTRAN PROGRAM FOR CALCULATING THE DEPLETION OF GADOLINIUM CYLINDERS. Pierre Descleve and Patrick Lacy (Allis-Chalmers Mfg. Co. Atomic Energy Div., Bethesda, Md.). July 15, 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(11-1)-1229. 30p. (EURAEC-1167)

DECYGAD is a FORTRAN program written for the IBM-704 and is designed to facilitate depletion calculations for gadolinium poison cylinders. Two high-cross section isotopes, ^{155}Gd and ^{157}Gd, are depleted. The analytical basis for the DECYGAD program is summarized, and the program description input and output are given. (auth)

36758 (HW-76885) ANALYSIS OF FAILURE MODES OF AUTOMATIC DISTRIBUTION CONTROL SYSTEM. R. Sherrard (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 7, 1963. Contract AT(45-1)-1350. 10p.

An analysis of failure modes of the Automatic Distribution Control System is presented. The system is an automatic system for detecting deviations from a manually established base and for controlling reactor flux distribution in each reactor zone relative to the desired base established for each zone. Power level or average flux in a zone is measured by means of a resistance temperature detector located in the effluent stream from selected process tubes. The system philosophy is oriented around the fail-to-neutral concept. (R.E.U.)

36759 (IITRI-578P21-6) STUDIES OF REACTOR CONTAINMENT. Summary Report. John B. Eichler, E. V. Gallagher, and Paul Lieberman (Illinois Inst. of Tech., Chicago. IIT Research Inst.). [1963]. Contract AT(11-1)-578. 92p.

Crushable shield analysis and design work was continued with a digital computer program designed to calcu-

late stress wave propagation in shield materials. The actual approach taken on the logical flow diagram for this computer code is examined in more detail and an attempt is made to explain, in physical examples, each section of the code. An over-all flow diagram that conceptually aids in the understanding of how each section of the code is related to the other sections is presented. Specific localities of the code in which troubles were found and areas of other potential errors are pointed out. Shock impingement experiments in crushable shields were devoted to the development of experimental measurement methods, for determination of the Hugoniot and isentrope relations for crushable materials. Although the test material was balsa, the measurement methods were also designed to treat the other five proposed crushable materials. Obtaining the Hugoniot and isentrope relations for balsa permitted the development of all the measurement methods and instrumentation techniques that would be required for obtaining the stress wave attenuation properties of other blast shield materials, within the pressure range of the shock tube blast facility. Test results thus far have shown that the static and dynamic compression behavior of balsa are the same, within the measurement capabilities of this experiment. The shock tube blast facility designed to accept specimens and instrumentation probes for tests in crushable materials is described. Special sensors designed to measure the stress-time history of crushable materials during impact, the free-surface velocity of the upstream air/solid impingement surface of the specimen, and the free-surface velocity of the downstream air/solid back surface of the specimen are described. Data analyzed consist primarily of transient pressure versus time records at several points in both the water (driver) and air (driven) sections of the shock tube. Following sudden rupture of a tempered glass diaphragm a rarefaction wave is shown to move into the liquid water dropping its pressure roughly to that of the air during a short duration metastable period of about one millisecond or less. Sudden evaporation of water then drove a shock into the air. The air shock overpressure increased with initial water temperature but was independent of water initial pressure. Air shock overpressures of about 30 psi and reflected pressures of 100 psi were measured. Design and fabrication of a new driver section with 2-in. ID and 72-in. length capable of handling water up to the critical point is described. (auth)

36760 (NAA-SR-9511) ON-LINE SHIM ROD CALIBRATION. E. A. Moore and C. L. Peckinpaugh (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Aug. 1, 1964. Contract AT(11-1)-Gen-8. 21p.

A technique for calibrating shim rods when on-line, using an analog reactor simulator, was proven feasible. This new method increases plant availability, eliminates operational hazards, and uses inexpensive analog equipment. It is not necessary to attach special devices to drive the control rod or to leave a pile oscillator in the reactor core. An accuracy of ±5%, compared with resolution of ±2% obtained when using zero-power period measuring techniques, was demonstrated with SRE Core II. It is predicted that an accuracy of ±3% can be achieved for the SRE Core III. This is sufficient to maintain an accurate reactivity history program for monitoring core normalcy without disrupting reactor operation. (auth)

36761 NUCLEAR REACTOR CONTROL. John Webb and Owen Hayden (to United Kingdom Atomic Energy Authority). British Patent 965,014. July 29, 1964. Filed Mar. 2, 1962.

An emergency control apparatus is designed for liquid metal-cooled reactors. The apparatus comprises a control rod which has a ferromagnetic head and is movable between an upper inoperative position and a lower operative position, and an electromagnetic grab which on de-energization releases the control rod. The grab also has a spring-loaded pin which, on de-energization of the grab, is sprung to assist the disengagement of the control rod head from the grab. (D.L.C.)

36762 DEVICE FOR THE TRANSMISSION OF KINETIC ENERGY AT THE TIME OF INSTANTANEOUS STOPPING OF A BODY IN MOVEMENT. Pierre Girard (to Commissariat à l'Energie Atomique). British Patent 965,104. July 29, 1964. Priority date Dec. 6, 1960, France.

A device is designed for absorbing the kinetic energy produced by the free fall of a control element into a reactor. The device comprises a drum fixed to a rotary shaft and on which is wound a flexible tie secured to the control element, and a flywheel mechanism for absorbing the kinetic energy. The operation of the device is described. (D.L.C.)

36763 IMPROVEMENTS IN AND RELATING TO CORE STRUCTURES FOR NUCLEAR REACTORS. Lamberto Paggi, John Oliver, and William MacRae (to The Nuclear Power Plant Co. Ltd.). British Patent 965,209. July 29, 1964. Filed Nov. 12, 1959.

A core structure for a gas-cooled graphite-moderated reactor is designed to solve problems arising from dimensional changes and to provide for interstitial channels. The structure comprises an assembly of graphite blocks with central channels and keying means on each side of the blocks. The blocks are of two different sizes, the smaller blocks being square and the larger blocks being octagonal and arranged so that alternate sides adjoin corresponding sides of adjacent blocks, with the square blocks filling the spaces between the octagonal blocks. The keys lie in three different planes each containing the central axes of the blocks, thus, increasing the stability of the assembly. Some of the keys may be eliminated so that interstitial channels can be formed. (D.L.C.)

36764 APPARATUS FOR EXTINGUISHING A CHEMICAL REACTION IN A NUCLEAR REACTOR. Didier Costes (to Commissariat à l'Energie Atomique). British Patent 965,403. July 29, 1964. Priority date Aug. 7, 1962, France.

An emergency apparatus is designed for extinguishing a fire in a vertical channel of a reactor. The apparatus comprises a magazine for storage of divided noncombustible material, e.g., steel shot, connecting means between the magazine and the channel, and means for feeding the material by gravity from the magazine to the channel. The apparatus may be used in a gas-cooled reactor using CO_2 as the coolant. (D.L.C.)

36765 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. (to Babcock and Wilcox Ltd.). British Patent 965,533. July 29, 1964. Filed Aug. 16, 1960.

A horizontal moderator block assembly is designed for a gas-cooled graphite-moderated reactor. The assembly comprises a plurality of square graphite blocks with their side faces in contact with one another; the block corners are chamfered so that temperature differences do not cause separation between adjacent faces of the blocks. The blocks are arranged so that their weight tends to maintain the integrity of the block assembly. (D.L.C.)

36766 IMPROVEMENTS IN OR RELATING TO REACTOR MODERATOR BLOCK ASSEMBLIES. (to Babcock and

Wilcox Ltd.). British Patent 965,534. July 29, 1964. Filed Aug. 16, 1960.

An assembly of graphite blocks is designed with bracing means for a gas-cooled reactor. The bracing means comprises adjustable laterally expansible wedge-shaped bracing units adapted to brace the blocks against one another by means of forces parallel to the axis of the assembly. The places of certain of the hexagonal graphite blocks are taken by the bracing units which act to limit the lateral forces produced by expansion of the moderator or the gaps produced by contraction. (D.L.C.)

36767 DEVICE FOR THE INSERTION OF NUCLEAR FUEL ELEMENTS WHICH HAVE NON-CIRCULAR, E.G. POLYGONAL CROSS SECTIONS, INTO NUCLEAR REACTORS. Ernst Rische (to INTERATOM). German Patent 1,169,043. Apr. 30, 1964. Filed Sept. 24, 1960.

Fuel elements with noncircular cross sections must in addition to being brought into an alignment with the axis of the channel be rotated around their axis to avoid a corner-wise setting on the support. This rotation can be achieved automatically by providing the circumference of the upper rim of the support with vertically tilted guiding devices, which guide the corners of the lowered and initially corner-wise fuel elements into the corners of the support. (Gmelin Inst.)

36768 EQUIPMENT FOR SERVICING A NUCLEAR REACTOR. Robert Tait, Robert Hugh Hall, and Charles John MacFarlane. German Patent 1,169,044. Apr. 30, 1964. Priority date July 19, 1957, Great Britain.

The equipment for servicing a reactor comprises a television camera of elongate form contained within a casing, a tool holder rotatable within the casing in front of the camera, and means passing between the casing and the camera for rotating the tool holder and for operating tools adapted to be fitted in the holder. (Gmelin Inst.)

36769 CONTROL ROD DRIVE FOR NUCLEAR REACTORS. Erhardt H. Baer and Heinz Acher (to Licentia Patent-Verwaltungs-GmbH). German Patent 1,169,596. May 6, 1964. Filed Apr. 30, 1960.

A control rod drive especially suited for boiling reactors is described. The drive is a combination of a mechanical drive and a hydraulic drive, which are arranged concentrically to each other. The coolant and/or moderator medium of the reactor is the hydraulic medium. For pressure compensation, the hydraulic system is connected to the reactor vessel by nozzles. (Gmelin Inst.)

36770 TRANSFER COFFIN FOR IRRADIATED FUEL ELEMENTS OF A NUCLEAR REACTOR. Nikolaus Bakos. German Patent 1,169,598. May 6, 1964. Filed Aug. 6, 1960.

For the removal of decay heat, the coffin is provided with a primary coolant circuit surrounding the fuel elements and a secondary coolant circuit, which connects the interior of the coffin with the heat exchanger on the outside. The coolant system for the secondary circuit including the heat exchanger is situated within and above the cover of the coffin. With this arrangement, natural circulation of the primary coolant is established, and as the holes are drilled solely in the cover, there is no danger of spilling the radioactive primary coolant. (Gmelin Inst.)

36771 POSITION CONTROL OF CONTROL ELEMENTS FOR NUCLEAR REACTORS WITH THE HELP OF A SYNCHRO SYSTEM. Bernhard Schallop. German Patent 1,170,083. May 14, 1964. Filed Mar. 13, 1961.

A stator connected synchro transmitter system is described in which the voltage induced in the rotor of the receiver is used to control automatically the position of the control element. As the control element is mechanically connected to the rotor of the emitter, the position of the element is predetermined by the azimuthal position of the rotor of the receiver. (Gmelin Inst.)

36772 SHIELDING DEVICE FOR A NUCLEAR REACTOR. Juergen Kraemer and Wolfgang Schimmel (to VEB Entwicklung and Projektrierung Kernzechnischer Anlagen). German Patent 1,170,084. May 14, 1964. Filed Aug. 5, 1960.

The reactor described comprises an inner pressure vessel containing the core and an outer container entirely surrounding the vessel. The mainly annular clearance between the inner vessel and the outer container is filled with steel balls of such a material that they have good shielding properties and low thermal conductivity. The balls may be removed either continually or discontinually to be used as active isotopes for special purposes. (Gmelin Inst.)

36773 LEAK DETECTION APPARATUS FOR GAS COOLED REACTOR. Ronald Hugh Campbell (to United Kingdom Atomic Energy Authority). U. S. Patent 3,145,148. Aug. 18, 1964. Priority date Apr. 27, 1959, Great Britain.

An apparatus of the type in which solid daughter products of fission products are collected on a wire, is designed for the continuous monitoring of reactor channels on a cross matrix system. The apparatus comprises a bank of precipitation chambers, a precipitation electrode extending through the chambers, and a bank of radiation detectors arranged along the electrode. The precipitation chambers and detectors are spaced similarly so that a signal occurring at a detector can be identified with a particular chamber. The operation of the apparatus is described in detail. (D.L.C.)

Criticality Studies

Refer also to abstract 36080.

36774 (CONF-627-1) FUTURE NEEDS FOR CRITICAL AND EXPONENTIAL EXPERIMENTS. J. L. Crandall (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). June 10, 1964. Contract AT(07-2)-1. 23p.

From European-American Committee on Reactor Physics, Hankø, Norway, June 1964.

Physics information required by reactor experimenters and operators, the accuracy of available information, and the information that can be furnished by exponential and critical experiments are evaluated to provide a basis for assessing the future needs for reactor experiments. (R.E.U.)

36775 (CRRP-1197) A METHOD OF CALCULATING NEUTRON ABSORPTIONS AND FLUX SPECTRA AT EPITHERMAL ENERGIES. F. E. Driggers (Atomic Energy of Canada Ltd., Chalk River, Ont.). May 1964. 56p. (AECL-1996)

A multigroup-multiregion method was developed for calculating flux spectra and neutron absorptions in a heterogeneous lattice cell at epithermal energies. A code, EPITHET, that utilizes this method was written in APEX language for the Control Data G-20 computer. Results obtained with EPITHET are compared with Hellstrand's empirical formulas for the resonance integrals of U metal and U oxide at 300°K using values recommended by Nordheim for the resonance integrals above 1000 ev—the unresolved range. Maximum deviations of about 2% are

obtained, which is within the standard deviation of the measurements. A total of 800 energy groups and 8 radial regions was used for each rod size. The total G-20 computing time for each rod size was 10 minutes. Spatial distributions obtained with EPITHET are compared with measurements in a CANDU-type lattice that were made at AECL using foil activation techniques and with a Swedish measurement of the neutron spectrum inside a uranium tube using a fast chopper. Typical deviations of 5 to 10% are obtained. (auth)

36776 (CRRP-1198) A G-20 PROGRAM TO CALCULATE BUCKLING FROM MICROSCOPIC EXPERIMENTS. I. H. Gibson (Atomic Energy of Canada Ltd., Chalk River, Ont.). June 1964. 22p. (AECL-1993)

Methods of calculating buckling from microscopic reactor physics experiments and using the four-factor two-group approach previously described by Märkl, were programmed for the G-20 computer with some small changes. The program was used on 7- and 19-element ZED II lattices. Calculated bucklings are in reasonable agreement with direct measurements. Full details of input requirements are given. (auth)

36777 (DP-873) MEASUREMENTS OF BUCKLINGS AND VOID EFFECTS IN D_2O-MODERATED, ORGANIC- OR H_2O-COOLED LATTICES OF UO_2 ROD CLUSTERS. Frederick D. Benton (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). June 1964. Contract AT(07-2)-1. 24p.

Material bucklings for a variety of UO_2 rod clusters on a triangular 9.33-inch lattice pitch in D_2O were determined by substitution experiments in the Process Development Pile. Measurements were made with clusters of 19, 31, and 37 half-inch UO_2 rods in which the coolant media were varied to include D_2O, H_2O, organics, or air. The bucklings, which were determined both by a one-group perturbation method and by a two-group flux matching method, ranged from 0.80 to 5.60 m^{-2}. (auth)

36778 (HW-81659) PHYSICS RESEARCH QUARTERLY REPORT, JANUARY, FEBRUARY, MARCH 1964. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 15, 1964. Contract AT(45-1)-1350. 56p.

Six sections are included: separate abstracts have been prepared for all. (T.F.H.)

For abstracts of individual items see: 36779, 36780, 36781, 36782, 36783, and 36849.

36779 (HW-81659(p.4-9)) EXPERIMENTS WITH PuO_2-UO_2 FUEL ELEMENTS IN LIGHT WATER. L. C. Schmid, W. P. Stinson, R. C. Liikala, and J. R. Worden (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Approach-to-critical, exponential, and critical experiments are carried out for H_2O-moderated UO_2-PuO_2-fueled lattices having moderator/fuel volume ratios of 2.71 to 5.14. The center-to-center spacing of the fuel elements varies from 0.71 to 0.90 in. Experimental results are compared with the predictions of one-dimensional, 4-group diffusion theory. (T.F.H.)

36780 (HW-81659(p.20-5)) COMPARISON OF THERMALIZATION MODELS. R. C. Liikala (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

An analysis of the use of various thermalization models has been made for a series of uranium and plutonium fueled critical solution experiments. The experiments were chosen to cover a large range of H/U and H/Pu atom ratios. Comparisons of calculated spectra and associated reactivities are made. The models utilized were Wilkins; Wigner-Wilkins; Maxwellian; and Nelkin. The Nelkin kernel was used in the code SPECTRUM while the other models were analyzed with TEMPEST. (auth)

36781 (HW-81659(p.26-32)) AN ANALYSIS OF URANIUM FUELED–LIGHT WATER MODERATED CRITICAL EXPERIMENTS. R. D. Liikala, J. R. Worden, and W. A. Reardon (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

A detailed analysis of five uranyl nitrate critical solution experiments and six 2.70-wt % enriched-uranium-dioxide critical experiments has been made. The critical solution experiments were analyzed to determine the reliability of the uranium cross section data utilized, thereby eliminating one of the potential uncertainties in the analysis of the heterogeneous experiments. The description of the methods utilized in these analyses together with the results are described. (auth)

36782 (HW-81659(p.33-44)) AN ANALYSIS OF PLUTONIUM–LIGHT WATER CRITICAL EXPERIMENTS. J. R. Worden, R. C. Liikala, and W. A. Reardon (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

A detailed analysis of three sets of critical experiments, at 1.8, 2, and 5 wt % Pu in Pu–Al alloys, has been made. These experiments all involved critical approaches using PuAl rods in light water at various lattice spacings. Three areas of potential difficulty in the analysis of plutonium systems were studied: the basic cross section data; calculation of the space-energy distribution of thermalized neutrons in a lattice cell; and methods of calculating the neutron absorption rate in the 1.056-ev resonance of ^{240}Pu. (auth)

36783 (HW-81659(p.45-8)) CRITICAL EXPERIMENTS WITH PuO_2–POLYSTYRENE COMPACTS. C. R. Richey, J. D. White, R. C. Lloyd, and E. D. Clayton (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Critical experiments on PuO_2–polystyrene compacts with a H/Pu atomic ratio of 15 are described. The Pu is 2.2% ^{240}Pu. Effects of a lucite reflector are taken into account. (T.F.H.)

36784 (IDO-16996) CRITICAL LOADING AND INITIAL STATIC EXPERIMENTS IN THE SPERT II REACTOR WITH A CLOSE-PACKED D_2O-MODERATED CORE. J. A. McClure and R. L. Johnson (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). June 1964. Contract AT(10-1)-205. 55p.

A highly enriched plate-type D_2O-moderated core containing 8.57 kg ^{235}U was installed in the Spert II reactor facility. A series of static physics experiments was performed on the core to determine its neutronic characteristics and to provide data for the analysis of self-limiting power excursion tests. The core had an available excess reactivity of 6.0$ at atmospheric pressure and 70°F. Flux measurements were made by activating gold foils. The adjoint flux was determined by measuring the reactivity worth of a perturbing poison at various locations in the core. The pressure coefficient of reactivity was small and positive being +0.087¢/psi. The void coefficient of reactivity was negative throughout the core and averaged $-0.025¢/cm^3$. The temperature coefficient of reactivity at ambient temperature was −0.45¢/°F and decreased to −3.98¢/°F at 250°F. (auth)

36785 (TRG-Report-83) A DIRECT METHOD OF CALCULATING THE EFFECTIVE DELAYED NEUTRON FRACTION IN A FAST REACTOR. R. G. Palmer (United Kingdom Atomic Energy Authority. Reactor Group, Dounreay, Caithness, Scotland). July 6, 1961. Reprinted 1964. 5p.

By suitable modification of the nuclear parameters, the effective delayed neutron fraction can be found directly by determining the difference in k_{eff} between two multigroup calculations, one being the normal delayed critical calculation and the other being a calculation in which the prompt neutrons only are considered. The Hassitt code was used to determine the β_{eff} of two ZPR III assemblies and the results are in good agreement with previous methods. (auth)

36786 (UCRL-7827) A NEW DERIVATION OF MULTIGROUP CROSS SECTIONS FOR BeO- AND GRAPHITE-MODERATED SYSTEMS. R. J. Doyas and E. H. Canfield (California. Univ., Livermore. Lawrence Radiation Lab.). Apr. 28, 1964. Contract W-7405-eng-48. 75p.

Multigroup (18-group) diffusion equation cross sections are rederived using updated numerical techniques and recent basic cross-section measurements. The basic series of Spade (BeO-moderated) and Snoopy (graphite-moderated) critical assemblies are calculated using these group constants, and the results are compared with those from earlier compilations. (auth)

36787 (UJV-957/63) O PŘECHODOVÝCH STAVECH REAKTORU PŘI VÝMĚNĚ ČLÁNKU. CAST 4. VÝMĚNA V REAKTORU S PROSTOROVĚ ZAVISLÝM TOKEM. (Transitional Compensation in Reactors During Replacement of Fuel Elements. Part IV. Reloading With Spatial Dependence of Neutron Flux). V. Bartošek and M. Hron (Československá Akademie Věd. Ústav Jaderného Výzkumu, Řež). Oct. 1963. 19p.

Transit compensation in reactors was studied considering the neutron flux spatial dependence. Magnitudes of transit coefficients and complete fuel loading times were employed. Calculations were made for four loading cycles for a cylindrical reactor of concentric layers with constant neutron flux along the radius. (R.V.J.)

36788 ANALYTICAL METHOD OF CALCULATION OF IRREGULAR FUEL BURNUP IN NUCLEAR REACTORS. I. S. Akimov and E. I. Grishanin. At. Energ. (USSR), 16: 500-4(June 1964). (In Russian)

An analytical method is developed for calculating irregular fuel burnup in reactors in which the excess reactivity is compensated by burnable poisons or by absorbers distributed evenly in the active zone during the whole run. Distributions of neutron flux at the end of a run in a flat reactor are presented for cases with and without reflectors. Results of present and previous calculations are compared. (M.J.T.)

36789 THEORY OF NEUTRON THERMALIZATION IN A CYLINDER SYMMETRICAL TWO-ZONE REACTOR CELL. H. Knesters. Thesis, Karlsruhe, Ger., Technische Hochschule, 1964. 127p. $2.00(Gmelin, AED-DISS. 64-17). (In German)

Thermal and epithermal neutron distributions in a symmetrical cylindrical two-zone reactor cell with natural U as fuel and D_2O as moderator are calculated. The moderator is assumed to be a monoatomic gas. The Boltzmann equation, which describes neutron transport, is solved for each cell. This leads to a system of coupled integral-differential equations, which are solved for epithermal energies. The influence of various parameters for the calculation of neutron spectra is discussed in detail. (Gmelin Inst.)

36790 THERMAL AND EPITHERMAL NEUTRON SPECTRA IN HETEROGENOUS REACTORS. H. Kunze. Thesis, Karlsruhe, Ger., Technische Hochschule, 1963. 78p. $2.00(Gmelin, AED-DISS 63-479). (In German)

A method to calculate neutron spectra in reactors of arbitrary arrangement and not necessarily identical fuel elements is given. Solution is a finite sum of Green's functions of the static Klein-Gordon equation. The energy dependence of the diffusion coefficient is taken into account. This leads only to a small spectrum change, but can be helpful in the understanding of neutron thermalization in heterogenous reactors. Spectra for various reactor types are given. (Gmelin Inst.)

Fuels

Refer also to abstracts 35641, 35642, 35643, 35644, and 35968.

36791 (HW-81600(p.3.1-14)) FUELS DEVELOPMENT. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Prevention of bonding between the cermet and steel mandrels during pneumatic impaction was achieved by application of an aluminum-oxide film to the steel mandrels. (auth)

36792 (HW-81600(p.4.1-28)) FUELS TESTING AND ANALYSIS. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Packed-particle power reactor fuel element technology was achieved with the attainment of exposures in excess of 5000 Mwd/ton in the PRTR. The postfailure behavior of full-size fuel elements, during operation in prototypic power reactor environments, is being determined by irradiation in the Fuel Element Rupture Test Facility (FERTF). Defective Al–Pu and swage-compacted UO_2 PRTR fuel elements were irradiated. Irradiation of off-standard UO_2–PuO_2 elements in PRTR supplied strong confirmation that oil and/or water contamination of the fuel was the cause of a recent series of cladding failures. A Mark-I fuel element was fabricated to include instrumented eddy current coils to define conditions which lead to impact (fretting) corrosion. A PRTR fuel element with misaligned end brackets, was tested in the TF-7 loop and the behavior of the element, under normal conditions, was observed to be similar to a standard element. Irradiation of hydrogen sintered, $(Th, Pu)O_2$ pellet capsules was completed in the MTR/ETR as part of a study of crossed progeny fuel cycles. Destructive examination of a twice rejuvenated, irradiated fuel rod revealed an homogeneous central region of ZrO_2–UO_2 solid solution. A UO_2 fuel rod was successfully irradiated at a surface heat flux of 655 w/cm^2. The heat transfer capabilities of a fuel rod with a roughened surface will be directly compared with one with a smooth surface during an irradiation test in the MTR. Four tungsten clad UO_2 capsules, designed to operate with totally molten cores, were irradiated to investigate the in-reactor compatibility of tungsten and molten UO_2. A capsule containing high-temperature-outgassed, impacted UO_2–1.5 wt % PuO_2 was examined after irradiation at 1050 w/cm^2 to 0.4×10^{20} fissions/cm^3. Ultrasonic inspection of the remainder of the EBWR cladding revealed a high reject rate (62%) on the last five lots examined. Irradiation of a defected thoria element in the MTR GEH-4 facility indicated that a failed element could be easily

located. Three ThO_2 elements were irradiated in the MTR to determine the effect of fuel density and exposure duration on ^{233}U production and fuel element performance. Two capsules containing pneumatically impacted uranium mononitride are being irradiated at the MTR. (auth)

36793 (LAMS-3107) QUARTERLY STATUS REPORT ON SOLID-PLUTONIUM FUELS PROGRAM FOR PERIOD JANUARY 1–MARCH 31, 1964. J. A. Leary, W. J. Maraman, W. N. Miner, and F. W. Schonfeld (Los Alamos Scientific Lab., N. Mex.). July 1964. Contract W-7405-eng-36. 14p.

The preparation and properties of PuO_2 and PuN pellets are described. The thermodynamic properties of Pu in $PuFe_2$ are studied. Phase studies on Pu–O and Pu–C–O systems are discussed. (T.F.H.)

36794 (NP-14204) RASPREDELENIE PLOTNOSTI NEITRONOV V REAKTORAKH S GLUBOKIM VYGORANIEM YADERNOGO TOPLIVA. (Neutron Density Distribution in Reactors with High Burnup of the Nuclear Fuel). B. Z. Torlin (Akademiya Nauk S.S.S.R. Institut Teoreticheskoĭ i Eksperimental'noĭ Fiziki, Moscow and U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energiĭ). 1964. 35p.

An influence of axial motion of the fuel on the burnup and spatial neutron flux distribution in a large reactor is investigated. The solution is expressed in elliptic integrals provided the dependence infinite lattice's multiplication factor on the burnup is approximated by the second power polynomial. The influence of the top and bottom reflectors on the physical parameters of the system under consideration is investigated. (auth)

36795 (UJV-1008/63) VYHOŘENI PŘÍRODNÍHO URANU PŘI AXIÁLNÍM POSUVU PALIVA V REAKTORU. (Effects of Axial Movement of Fuel on Burnup of Natural Uranium). V. Bartošek and V. Lelek (Československá Akademie Ved. Ustav Jaderného Výzkumu, Řež). Jan. 1964. 24p.

The influence of the axial movement of fuel on the flux distribution and burnup of uranium in the reactor is investigated. Using a simplified model, which takes into account the change of the multiplication coefficient in consequence of the burnup, it is demonstrated that the operation with one-way shift increases the obtainable burnup by about 10% against the operation with the continuous exchange of the whole elements. Besides, it improves the thermo-technical conditions in the element while the shift in two opposite directions increases the burnup by about 35% without substantial influence on the thermo-technical conditions. The numerical results are performed for natural-uranium, heavy-water systems. (auth)

36796 (EURAEC-1077(Suppl.)) PLUTONIUM RECYCLING. Quarterly Progress Report No. 14 Supplement, Covering the First Quarter of 1964. (France. Commissariat à l'Énergie Atomique, Paris). Work Performed under United States–Euratom Joint Research and Development Program. Contract 037-60-12-RDF. 6p. (A translation)

Analyses of the neutron spectra in Marius are described. The use of oscillation techniques for studying the local signal propagation and signal variations as functions of rod position and displacement in Minerva is discussed. (T.F.H.)

36797 THE NUCLEAR FUEL ELEMENT: AN EXERCISE IN METALLURGY. H. M. Finniston (International Research and Development Co., Ltd., Newcastle-upon-Tyne, Eng.). J. Inst. Metals, 92: 385-97(Aug. 1964).

Metallurgical developments in nuclear fuel technology are reviewed. Problems and their solutions relating fuel elements of the present and some future generations of reactors serving U.K. industry are discussed. Developments in casting, irradiation effects, heat-treatment of U metal, sheathing materials, new fuel elements, change from uranium metal to oxide, UO_2, Pu, canning materials, Be, Zr, and stainless steel are included. (P.C.H.)

36798 FUEL ELEMENT ASSEMBLIES. David Colin Emerson (to United Kingdom Atomic Energy Authority). U. S. Patent 3,142,627. July 28, 1964. Filed Oct. 26, 1959.

A reactor fuel rod cluster is designed in which the tendency of the rods to bow is reduced. The rods are supported in tension from thin plates which in turn are supported and laterally stabilized by thin deep webs, the webs being provided with small projections reaching to the rods. (D.L.C.)

36799 FUEL-MODERATOR ELEMENT FOR A NUCLEAR REACTOR AND METHOD OF MAKING. James D. Gylfe (to North American Aviation, Inc.). U. S. Patent 3,145,150. Aug. 18, 1964. Filed Jan. 4, 1960.

A combination fuel-moderator fuel pin is designed for use in steam-superheat reactors. The fuel pin comprises a zirconium hydride tube filled with UO_2 pellets and clad with a thin stainless steel tube, and reflector or moderator plugs of zirconium hydride are provided at the ends of the pin. The advantages of the pin are reduced neutron absorption and fission gas release and increased power density. (D.L.C.)

36800 FUEL ELEMENTS FOR NUCLEAR REACTORS. Ian Hugh Morrison (to United Kingdom Atomic Energy Authority). U. S. Patent 3,145,152. Aug. 18, 1964. Priority date Mar. 2, 1960, Great Britain.

A fuel element of the finned type for gas-cooled reactors is designed with means for displacing the fuel element laterally to prevent vibration in the channel. The fuel element, besides the helical heat transfer fins and longitudinal splitter fins, is provided with upper and lower end locating members. The lower end locating member comprises two parts in inclined sliding engagement with each other. When the fuel element is lowered onto the top of an adjacent fuel element, the two parts slide relatively to each other to tilt the fuel element in the channel until its splitter fins contact the channel wall. (D.L.C.)

Power and Power-Breeder Reactors

Refer also to abstracts 35691 and 36245.

36801 (AD-437833) FEASIBILITY STUDY — FLOATING MOUNT NUCLEAR POWER PLANT. (Bureau of Yards and Docks). Nov. 8, 1963. Contract NBy-45824. 114p.

The state-of-the-art with regard to nuclear power technology for use as the primary energy source in a 20,000-kwe (net) power plant mounted on a non-self-propelled barge is presented. In order to evaluate the economic feasibility of the nuclear power plant, the comparable cost for conventional fossil-fuel-fired plant is also presented. The report includes descriptions of the advanced and present-day reactor concepts together with conceptual drawings, construction cost estimates, design and construction schedule, and estimates of annual fuel, operating, and maintenance costs. (auth)

36802 (ANL-6837) SOME METALLURGICAL CONSIDERATIONS IN THE DESIGN AND OPERATION OF THE TOP SEAL OF EBR-II. B. Blumenthal, L. R. Kelman, H. V. Rhude (Argonne National Lab., Ill.). Apr. 1964. Contract W-31-109-eng-38. 22p.

The top seal of EBR-II is a molten bismuth–tin eutectic alloy. Its design and operation raised a number of questions pertaining to the oxidation of the liquid metal, its compatibility with the container material, and segregation during thermal cycling. An apparatus was built simulating a rotary seal, which allowed observation of the behavior of the liquid metal over a period of 70 days, its drossing characteristics, and compatibility with Type 304 stainless steel under the experimental conditions of rotation and temperature. Repeated thermal analyses caused the alloy to segregate substantially. The influence of sodium on the segregation was determined. Specific recommendations are made regarding the design and operation of liquid metal seals. (auth)

36803 (CVNA-209) MONTHLY OPERATING REPORT [ON CVTR OPERATION], JUNE 1964. (Carolinas Virginia Nuclear Power Associates, Inc., Parr, S. C.). Contract [AT(30-1)-2289]. 30p.

The reactor was operated at full licensed power of 44.3 Mw(t), (11.3 Mw(e)), during the first three weeks of June. After that the reactor was intentionally scrammed to begin the xenon tests, which concerns xenon buildup following reactor shutdown. Higher plant radiation levels, radioactivity levels in plant systems, and air contamination levels were observed with increased reactor operation at power. Heavy water and light water plant systems generally remained within chemical specification limits. Some ammonia production was observed in the primary coolant, apparently as a result of some air or nitrogen entering the system. (auth)

36804 (DL-58) FUELLING HIGH-CONVERSION-RATIO REACTORS. W. B. Lewis (Atomic Energy of Canada Ltd., Chalk River, Ont.). Aug. 1963. Reprinted Feb. 1964. 14p. (AECL-1911; CONF-178-3)

From European Atomic Energy Society's Symposium on Fuel Cycles for Power Reactors, Baden-Baden, Ger., Sept. 1963.

Economic considerations in the fabrication and processing of fuels for power reactors, and future needs for reactor fuels are discussed. (R.E.U.)

36805 (NAA-SR-9033) BOILING DEPRESSURIZATION TRANSIENTS. F. J. Halfen and F. Berganzoli (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Aug. 1, 1964. Contract AT-11-1-GEN-8. 88p.

An analytical and experimental effort toward a better understanding of the mechanisms involved in nuclear power reactor loss-of-pressure accidents is presented. A simplified analytical model that can be used to describe the transient hydraulic and heat transfer behavior of organic-cooled reactors during depressurization accidents resulting in bulk boiling of the coolant was developed as part of this effort. Correlations of void fraction and heat transfer and dynamic equations for the flow system are incorporated into this model. Predictions of the hydraulic and heat transfer behavior were verified experimentally to establish the applicability of the model and equations involved. (auth)

36806 (NAA-SR-9430) NUCLEAR PARAMETERS OF THE SRE CORE II. R. W. Keaten, R. D. Phelps, and A. L. Gunby (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Aug. 1, 1964. Contract AT-11-1-GEN-8. 37p.

A method of calculation of nuclear parameters was developed for the second core loading of the SRE. The calculated effective multiplication constant for the measured critical loading is 0.994. Other parameters such as temperature coefficients were calculated within 10% of the experimental values. The results have permitted a significant improvement in the monitoring of reactivity to determine core normalcy. (auth)

36807 (NAA-SR-9473) PIQUA NUCLEAR POWER FACILITY OPERATIONS ANALYSIS PROGRAM. Progress Report No. 3, July 1, 1963–December 31, 1963. J. J. Auleta, S. F. Burton, H. S. Cole, et al. (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). July 15, 1964. Contract AT(11-1)-Gen-8. 122p.

The operations and test results on the Piqua Power Reactor are reviewed. During the period under survey, the reactor generated about 4460 Mwhr of heat, at power levels up to 20 Mw(th). (T.F.H.)

36808 (PAN-494/IX) PROPOZICJA W SPRAWIE WYBORU KIERUNKU ROZWOJU PIERWSZEJ GENERACJI ELEKTROWNI JADROWYCH W POLSCE. (Proposals as to the Choice of a Line of Development for the First Generation of Nuclear Power Stations in Poland). T. Wójcik (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). 1964. 17p.

On the basis of economics studies and of an analysis of fuel resources and needs, it is expected that construction of full-scale nuclear power stations will start in Poland about 1980. To enable the industry to acquire the experience necessary for the realization of these tasks it is planned to build in Poland the first medium scale nuclear power station by 1975. This first power station should be of the same type as the next ones to be constructed, in order to take the greatest possible advantage of the experience acquired. An analysis of economic, political, and technical factors, taken into consideration when choosing the right type of a nuclear power station for Polish conditions, was performed. Its results show that the choice of power stations with reactors fueled with enriched uranium, cooled with water, and moderated with water or graphite is purposive as a line of development of the first generation of nuclear power stations in Poland. (auth)

36809 (SRO-105) HEAVY WATER POWER REACTOR PROGRAM MONTHLY PROGRESS REPORT, JULY 1964. (Savannah River Operations Office, AEC). 7p.

A review is presented of: creep-rupture testing of SAP-895 and SAP-915; boiling-burnout and heat-transfer studies on 19-rod fuel bundles; D_2O separation technology; fuel element design and operations of HWCTR; CANDU fuel assembly testing in HWCTR; and CVTR operations. (T.F.H.)

36810 (TID-3313) U.S. POWER REACTORS. A Bibliography of Selected Literature. Richard J. Smith and Henry D. Raleigh, comps. (Division of Technical Information Extension, AEC). Mar. 1964. 230p.

A total of 1380 references to unclassified reports and published literature is presented on 16 power reactors in the United States. All phases of research and development except reactor fuel reprocessing and waste disposal are covered. Author, report number and availability, and subject indexes are provided. (auth)

36811 (WANL-PR(S)001-A) ENGINEERING STUDY OF NUCLEAR POWER PLANT FOR MANNED LUNAR

BASES. Monthly Report. (Westinghouse Electric Corp. Astronuclear Lab., Pittsburgh). Sept. 30, 1963. Contract DA49-129-eng-NASA-1. 57p. (AD-439837)

Mass, shielding, reactor-type, environmental, and conceptual studies on a nuclear power plant for a manned lunar base are reported. (T.F.H.)

36812 (AEC-tr-6462) I. V. KURCHATOV BELOYARSK NUCLEAR POWER PLANT. P. I. Aleshchenkov, Yu. I. Mityaev, G. D. Knyazeva, L. I. Lunina, A. D. Zhirnov, and V. M. Shuvalov. Translated from At. Energy. (USSR), 16: 489-96(1964). 28p. (Includes original, 9p.).

The design and operational characteristics of the first and second Beloyarsk Nuclear Power Plants are described. The superheating cycle is described. (R.E.U.)

36813 (AEC-tr-6463) OPERATION OF THE FIRST NUCLEAR POWER PLANT IN THE WORLD. G. N. Ushakov, L. A. Kochetkov, V. G. Konochkin, V. S. Sever'yanov, V. Ya. Kozlov, and O. A. Sudnitsyn. Translated from At. Energ. (USSR), 16: 484-8(1964). 19p. (Includes original, 5p.)

The design and operation of the first Russian power reactor, a boiling-superheat reactor, are discussed. (R.E.U.)

36814 CONSIDERATIONS IN THE TRANSFER OF THERMAL ENERGY IN POWER REACTORS. C. A. Nobili. Calore, 35: 212-19(May 1964). (In Italian)

The thermal energy transfer efficiency of gas–graphite reactors for nuclear power stations is considered. The factors affecting the increase of the present possibilities are examined, and particular features for improving the thermal energy transfer efficiency are considered. (C.E.S.)

36815 KEEPING THE CANDU SYSTEM COMPETITIVE. Can. Chem. Process., 48: No. 5, 49-52(May 1964).

It is shown that Canada's nuclear industry must be able to supply the CANDU type reactor with less lead time than now taken and to press the development of the system to higher performance and reduce cost so that it will be competitive for many years. (C.E.S.)

36816 COMPUTER SIMPLIFIES CONTROL OF CANDU. Can. Chem. Process., 48: No. 5, 65-7(May 1964).

The digital computer control system for the CANDU Reactor is described. The functions of the computer system are outlined, and an automatic check and self-check on computer performance are discussed. (C.E.S.)

36817 HOW CORROSION AFFECTED DESIGN OF CANDU. D. G. Boxall (Canadian General Electric Co., Ltd., Peterboro, Ont.). Can. Chem. Process., 48: No. 5, 69-72(May 1964).

The corrosion problems encountered wherever hot water and steam are handled are briefly discussed, and the specific corrosion problems encountered in the design of the CANDU Reactor are described. (C.E.S.)

36818 SOME TOPICAL ATOMIC POWER QUESTIONS. Sigvard Eklund. Intern. At. Energy Agency Bull., 6: No. 3, 7-16(Aug. 1964).

The present and projected power requirements of the world are briefly discussed in relation to fossil and fissile fuel resources. The development and status of civilian nuclear power are outlined and the economics of nuclear power are discussed, with particular emphasis on the Oyster Creek station. (D.C.W.)

36819 TEN YEARS OF NUCLEAR POWER. Intern. At. Energy Agency Bull., 6: No. 3, 17-25(Aug. 1964).

The factors prompting nuclear power development are indicated, and the various national programs are briefly discussed, including efficiency, reactor development, application, and motivation. The more important findings are summarized. (D.C.W.)

36820 CONVENTIONAL ENERGY AND NUCLEAR ENERGY IN THE USA. Franco Fiorio. Rivoluzione Ind., No. 134, 19-21(Feb. 1964). (In Italian)

The efforts of the nuclear industry to make nuclear energy competitive with conventional energy in the USA are outlined. The difficulties in reassuring the public on the comparative safety of power reactors in heavily populated centers are discussed, as well as the unit costs of reactors as a function of the reactor size. It is concluded that only large-scale reactors can compete with conventional power plants. (J.S.R.)

36821 ENTRY INTO THE NATIONAL NETWORK OF THE FIRST 45 Mwe OF THE GARIGLIANO CENTER. Alberto Brunetti. Rivoluzione Ind., No. 134, 22-4(Feb. 1964). (In Italian)

In February the first 45 Mwe from the Garigliano nuclear power station were introduced into the national network. The characteristics of the reactor are summarized. (J.S.R.)

36822 CONTROL OF THE POWER OUTPUT OF A REACTOR BY CONTROLLING THE HEAT TRANSFER IN THE COOLING LOOP. H. Law. Rivoluzione Ind., No. 134, 52-3 (Feb. 1964). (In Italian)

In the Sizewell nuclear power station, the output power is controlled by measuring and controlling the transfer of the thermal power from each of the four coolant circuits to the CO_2. The system designed to measure and control this heat transfer is described. (J.S.R.)

36823 THE HALDEN BOILING WATER REACTOR. Rivoluzione Ind., No. 136, 21-5(Apr. 1964). (In Italian)

The design and characteristics of the Halden Reactor are reviewed. The reactor vessel, core, heat transfer circuits, heavy water circuit, and secondary and tertiary circuits are described. The assembly of the second fuel loading is illustrated. The control system and nuclear instrumentation of the reactor are also considered. (J.S.R.)

36824 OPERATIONAL DATA ON THE FIRST ATOMIC POWER PLANT. G. N. Ushakov, L. A. Kochetov, V. G. Konochkin, and V. S. Severyanov. Teploenergetika, No. 6, 5-7(June 1964). (In Russian)

Descriptions are given of the technological and physical properties and efficiency of the First Soviet Atomic Power Reactor. Data on fuel rod performance and burnup show that 70% of the rods had lifetimes 1.5 to 3.5 times that anticipated. The performance of the control rods, coolant circuit, and moderator graphite are also discussed. (R.V.J.)

36825 SUPERHEATED ATOMIC POWER PLANTS AND THEIR THERMAL EFFICIENCY. T. Kh. Margulova, L. S. Sterman, and K. Khaiduk (Moscow Inst. of Power Engineering). Teploenergetika, No. 6, 7-10(June 1964). (In Russian)

The economic efficiency of superheated atomic power plants and their thermal performance are discussed. The efficiency factors of plants with various parameters are tabulated. (R.V.J.)

36826 FUNCTIONAL DIAGRAMS AND CONTROL OF THE FIRST NUCLEAR POWER PLANT. A. F. Popov. Teploenergetika, No. 6, 10-15(June 1964). (In Russian)

The control panel and circuitry are described, and operational and emergency control are discussed. (R.V.J.)

36827 DOSIMETRIC AND RADIATIVE TECHNOLOGICAL CONTROL OF THE FIRST ATOMIC POWER PLANT.

P. A. Zabelin. Teploenergetika, No. 6, 16-19(June 1964). (In Russian)

In the service building the γ dose is negligible. The surface activity in some compartments is about 2×10^3 β decays/150 cm^2/min; the atmospheric radioactivity does not exceed 2×10^{-5} C/l. During repair some areas were contaminated to 5×10^3 to 3×10^4 β decays/150 cm^2/min, but were easily decontaminated. Radioactive gases and aerosols not exceeding 2×10^{-9} to 2×10^{-8} and 3×10^{-14} to 10^{-12} C/l, respectively, were observed several times. Special ventilation and air controls prevented any effect on the personnel. Contamination from accidents in technological channels (wet or dry) have been brought under control within 1 to 3 days. (R.V.J.)

36828 ON THE PROBLEMS OF ANALYTICAL DETERMINATION OF OPTIMUM PARAMETERS OF ATOMIC POWER PLANTS BY STANDARD METHODS. Yu. D. Arsen'ev and S. I. Smirnov. Teploenergetika, No. 6, 22-6(June 1964). (In Russian)

An approximation method for determining optimum parameters for atomic power plants was developed. The obtained analytical relations were verified by subsequent calculations on a plant with a water-cooled, water-moderated reactor. (R.V.J.)

36829 NUCLEAR REACTOR AND METHOD OF OPERATING SAME. Milton C. Edlund (to The Babcock and Wilcox Co.). U. S. Patent 3,142,624. July 28, 1964. Filed Apr. 14, 1960.

A thermal breeder reactor is designed in which the reactivity is controlled by varying the D_2O-H_2O ratio of the moderator. A 610-Mw(t) reactor of this type is described and compared with similar reactors using conventional control; the results show that control by variation of moderation results in longer life and higher conversion ratio. (D.L.C.)

36830 NUCLEAR REACTOR PLANT WITH INSPECTION AND REPROCESSING STATIONS. William W. Wellborn (to Firth Sterling, Inc.). U. S. Patent 3,142,625. July 28, 1964. Filed Dec. 7, 1959.

A power reactor is described in which ball-shaped fuel elements are moved, inspected, and replaced if needed. Thus, the reactor is operated on a continuous, long-term basis without shutdown. The various components and operation of the reactor are described. (D.L.C.)

36831 NUCLEAR REACTION ELEMENT. William W. Wellborn (to Firth Sterling, Inc.). U. S. Patent 3,142,626. July 28, 1964. Filed June 15, 1956.

A ball-shaped fuel element is designed for use in a reactor for continuous power generation. In this reactor, the fuel balls are moved, inspected, and replaced, and the reactor need never be shutdown for recharging. Several embodiments of the fuel ball are described. (D.L.C.)

36832 BOILING NUCLEAR REACTOR AND FUEL ELEMENT THEREFOR. Donald H. Imhoff (to General Electric Co.). U. S. Patent 3,145,149. Aug. 18, 1964. Filed Nov. 4, 1958.

A boiling power reactor is provided with fuel elements designed so that flatter neutron flux and power distributions result without wasteful neutron absorption. In the fuel elements, the concentration of fissile material is varied in the direction of coolant flow. Thus, the reactivity reduction due to boiling is compensated for. Several embodiments of the fuel elements are described. (D.L.C.)

Process Heat Reactors

36833 (TID-20039) REPORT OF LARGE LOW-PRESSURE STEAM REACTOR REVIEW GROUP. (Division of Reactor Development, AEC). Mar. 1963. 38p.

Capital costs, fuel cycle costs, and operating costs are reviewed for light water-moderated and -cooled pressurized reactors, and graphite- and heavy water-moderated reactors for steam production for water desalination. Dual-purpose (desalination and electric power production) operations were not considered. The current status and near-term potentials, effect of scaling-up of size, and the research and development programs are reviewed. No determination was made as to the reactor concept that would be best suited to desalting plants. (R.E.U.)

36834 APPENDICES TO AN ASSESSMENT OF LARGE NUCLEAR POWERED SEA WATER DISTILLATION PLANTS. (Task Group on Nuclear Power and Saline Water Conversion). Mar. 1964. 484p. $3.25 (GPO).

Technical design and performance data are given for dual-purpose power plants for 1500 to 25,000 Mw(t) using boiling reactors, pressurized reactors, heavy water reactors, organic-cooled reactors, liquid metal-cooled reactors, high-conversion reactors, enriched-fuel reactors, and fast breeder reactors. Power value estimates for the dual-purpose desalination plants are presented. Methods of desalination are discussed. Evaluation of potential water markets in southern California coastal areas is considered. Federal Reclamation financial criteria are applied in assessing the large distillation plants. "Assessment of Large Nuclear Powered Sea Water Distillation Plants" was included in NSA 18: 19403. (R.E.U.)

Production Reactors

Refer also to abstract 35853.

36835 (HN-148) EARTHQUAKE RESISTANCE OF THE HANFORD NEW PRODUCTION REACTOR. Final Report. (Holmes and Narver, Inc., Los Angeles). June 1960. For General Electric Co., Hanford Atomic Products Operation, Richland, Wash. Contract AT(04-3)-174. 256p.

Seismic criteria are proposed for certain features of the New Production Reactor (NPR) now under design. Earthquake response is analyzed for building and reactor components. (R.E.U.)

36836 (ORNL-TM-902) SPECIFICATIONS FOR HIGH FLUX ISOTOPE REACTOR FUEL ELEMENTS—HFIR-FE-1. G. M. Adamson, Jr., and J. R. McWherter (Oak Ridge National Lab., Tenn.). July 1, 1964. Contract W-7405-eng-26. 47p.

Requirements for two types of aluminum-base fuel elements for HFIR are given: included are materials of construction, fabrication, assembly, inspection, and quality control. (R.E.U.)

Propulsion and Space

Refer also to abstracts 35701 and 35929.

36837 (IITRI-C6007-12) ABLATION PRODUCT COALESCENCE. Final Report, February 15, 1963–February 14, 1964. John Stockham and Richard Snow (Illinois Inst. of Tech., Chicago. IIT Research Inst.).

Mar. 13, 1964. For Sandia Corp., Albuquerque, N. Mex. Contract AT(11-1)-578. 60p. (SC-DC-64-458)

Radiological safety requires that the nuclear auxiliary power systems designed for space applications ablate during reentry and that the debris remain suspended in the atmosphere until the activity has decayed to a safe level. The debris from an ablating object can agglomerate, producing particles which could cause a radiation hazard from fallout. Agglomeration of silver aerosols was studied by measuring the particle sizes after quenching. The vapor was produced at reduced pressures and at temperatures below the boiling point of the metal. Experimental conditions favored self-nucleation. A computer program using an agglomeration model derived from the kinetic gas theory and the Smoluchowski diffusion theory provided a theoretical measure of the aerosol particle sizes. The particle sizes determined experimentally and by the computer program were in substantial agreement, especially at the lower mass concentrations studied. At the higher concentrations the experimental data scattered and deviated from the theoretical values, since the particles tend to chain and form branched aggregates. The particle sizes of the aggregates depended on the mass concentration of the aerosol. The computer program can be used to predict particle sizes, once conditions such as concentration, altitude, and ablation train diameter are known. (auth)

36838 (NAA-SR-8399) SNAP 10A-PSM-1 TEST RESULTS. R. M. Oliva (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). July 15, 1964. Contract AT(11-1)-Gen-8. 87p.

Results of the environmental test program, which was conducted on the SNAP 10A Prototype System Mockup, PSM-1, to ascertain the dynamic characteristics of the structural design and to qualify the basic structure for the anticipated launch environment. Included are results of: (1) vibration testing in each of three mutually perpendicular axes, (2) acoustic test, and (3) special vibration surveys and tests. The following supplemental program activities are also included: (1) the highway transportation of a simulated test vehicle, and (2) a sled test program for simulating an acceleration environment. (auth)

36839 (NAA-SR-9479) AEROSPACE SAFETY PROGRAM. SNAP-10A REENTRY FLIGHT DEMONSTRATION (RFD-1) ANALYSIS OF FLIGHT-TEST DATA. R. D. Elliott (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). July 15, 1964. Contract AT(11-1)-Gen-8. 56p.

A full-scale, nonradioactive model of the SNAP 10A reactor was launched into a suborbital trajectory to obtain data on reentry heating which could be used to predict the mode of disintegration of an actual reactor returning from a satellite orbit. This flight test was conducted as a part of the Aerospace Safety Program. The results of the analysis of data obtained from this flight test are presented. (auth)

36840 (NAA-SR-9723) BEHAVIOR OF SNAP-10A DURING ORBITAL REENTRY. D. K. Nelson (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). July 15, 1964. Contract AT(11-1)-Gen-8. 30p.

An analysis of the SNAP 10A power system during orbital re-entry to gain information regarding the ablation of various reactor components. The SNAP 10A power system uses thermoelectric elements to convert the heat developed by a compact nuclear reactor into electrical energy. The initial point in the analysis occurs, after system operation in space, at an altitude in the process of satellite orbit decay where the satellite will not make another complete circuit of the earth. The analysis considered an oblate rotating earth. Results show that the SNAP 10A vehicle has aerodynamic stability with the reactor pointed forward into the airstream, and oscillates about the flight path during re-entry. The amplitude and frequency of these oscillations were analyzed with respect to time and altitude for a system with two degrees of freedom. It is shown by the analytical study that the SNAP 10A reactor is ablated to an extent where individual fuel rods are released and subjected directly to aerodynamic heating. The transient heating applied to the reactor system during re-entry results in ablation of the forward section of the reactor and adjacent light-weight components at altitudes near 300,000 ft. The heavier components with a greater heat capacity and some parts that were previously shielded rise in temperature until the reactor separates from the SNAP 10A system. This event is followed by individual fuel element release at about 240,000 ft. (auth)

36841 (NAA-SR-9820) STRUCTURAL TEST ON THE FINAL SNAP-10A PROTOTYPE SYSTEM (PSM-1A). H. L. Henley and W. H. Dauterman (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). July 15, 1964. Contract AT(11-1)-Gen-8. 81p.

Results of the structural tests that were performed on the S10A-PSM-1A system to qualify the basic structural design for the anticipated launch environment are given. Included are data from the damping, vibration, shock, acoustic, and static test programs. Testing was performed in accordance with NS10 PSM-1A-00-001, "PSM-1A Structural Test Specification." The SNAP 10A basic structural design was successfully qualified during this environmental test program. In addition to demonstrating an acceptable structural design, many important static and dynamic characteristics were observed that will be invaluable in SNAP 10A structural analysis and in future design applications. (auth)

36842 (NAA-SR-9899) SNAP-10A REACTOR STRUCTURE. J. D. Sutherland (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Aug. 1, 1964. Contract AT(11-1)-Gen-8. 31p.

The design and fabrication of the SNAP 10A reactor structure are described, and results of structural analyses and tests of the reactor are presented. (auth)

36843 (SC-RR-64-968) REENTRY FLIGHT DEMONSTRATION NUMBER TWO (RFD-2): SPECTROGRAPHS, PHOTOMETERS, AND EVENT CAMERAS DEVELOPED FOR SNAP REENTRY STUDIES. Dan Parsons (Sandia Lab., Albuquerque, N. Mex.). Aug. 1964. Contract AT (29-1)-789. 28p.

Spectrographs, photometers, and event cameras were developed for use in attempting to record the disassembly of an inert nuclear power supply and the complete ablation of inert fuel rods during an actual re-entry operation, RFD-2, to be conducted off the island of Bermuda. (auth)

36844 (TID-20426) NS SAVANNAH VENTILATION SYSTEM FILTER TESTING. Status Report. R. E. Grossman (Atomic Energy Commission, Washington, D. C.) and W. G. Thomson (Babcock and Wilcox Co., Galveston, Tex.). Nov. 1963. (STS-4). 28p.

System specifications and criteria are given. Filter-absorber train test methods and ventilation system performance are discussed. (R.E.U.)

36845 GASEOUS NUCLEA .OCKET WITH MHD VORTEX FUEL CONTAINMENT. K. O. Kessey and R. A. Gross (Columbia Univ., New York). AIAA (A t. Aeron. Astronaut.) J., 2: 1461-4(Aug. 1964).

The limitations and potentialities of m in which the gaseous fuel is separated from the h gen propellant by a hydromagnetically driven vortex were investigated. The reactor dimensions and power, flow limitations, exhaust gas properties, and electrical power requirements were determined. (D.C.W.)

36846 MERCURY SPACE POWER SYSTEMS. R. E. Henderson and E. H. Hietbrink (General Motors Corp., Indianapolis). Paper 16 of "Direct Conversion." New York, American Institute of Electrical Engineers, 1962. 12p.

A Hg Rankine system and a Hg-K liquid metal cell, both using the SNAP II reactor, are briefly described; and the characteristics, merits, and limitations of the two systems are summarized. (D.C.W.)

Research and Test Reactors

Refer also to abstracts 35695 and 36582.

36847 (AECL-1974) SOLID STATE FLOW MONITORING TRIP AND ALARM SYSTEM FOR THE NRU REACTOR. B. J. Reel (Atomic Energy of Canada Ltd., Chalk River, Ont.). Apr. 1964. 17p.

The rod cooling water flow is measured by means of a differential pressure cell connected to the input and output of each rod cooling system. The output of the dp cell is measured by means of a pneumatic pressure meter which is fitted with solid-state trip and alarm circuits. The outputs of the trip and alarm circuits are fed to separate logic gates and these operate trip and alarm relays when any one or more of the pressure measurements falls below preset levels. (auth)

36848 (AID-P-64-13) THE FIRST SOVIET NUCLEAR REACTOR. Summary of Data. (Library of Congress. Aerospace Information Div., Washington, D. C.). Mar. 9, 1964. 9p. (AD-434446)

The construction and characteristics of the first Soviet research reactor are discussed. The reactor was natural uranium fueled and graphite moderated; construction began in 1945. (R.E.U.)

36849 (HW-81659(p.10-19)) MEASUREMENT OF THE ABSORPTION AND FISSION SENSITIVITIES IN THE D_2O-MODERATED PLUTONIUM RECYCLE CRITICAL FACILITY. B. Arcipiani and L. C. Schmid (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

The sensitivities of the Plutonium Recycle Critical Facility (PRCF) to absorption and fission were measured in two test cells occupying the center position of the reactor. In one case the test cell was made up of an aluminum guide tube and an aluminum thimble containing a PuAl 19-rod cluster with no moderator (Spectrum I); in the other case the test cell was made up of an aluminum guide tube and an aluminum thimble containing a single PuAl center rod in light water (Spectrum II). (auth)

36850 (LAMS-3112) QUARTERLY STATUS REPORT ON ULTRA HIGH TEMPERATURE REACTOR EXPERIMENT (UHTREX) FOR PERIOD ENDING JUNE 20, 1964. (Los Alamos Scientific Lab., N. Mex.). July 1964. Contract W-7405-eng-36. 20p.

A summary is presented of the construction, components, He blowers, He cooling system, systems analysis, neutronic calculations, graphite corrosion, and fuel element preparation for UHTREX. (T.F.H.)

36851 SAFETY AND CONTROL EQUIPMENT FOR A REACTOR OF A NUCLEAR POWER STATION. APPLICATION TO THE FIRST BELGIUM NUCLEAR POWER STATION, BR-3. Maurice Gueben. Bull. Sci. Assoc. Ing. Elec. Inst. Electrotech. Montefiore, No. 2, 113-34(Mar.-Apr. 1964). (In French)

Fission and the chain reaction are briefly discussed, particularly the safety problems associated with the chain reaction. The operational principles of the BR-3 plant are then summarized; and the control and safety principles and systems adopted for the plant are described and illustrated. (D.C.W.)

36852 CONTROL OF NUCLEAR REACTOR BR-2. Henri Couez and Désiré Sienack. Bull. Sci. Assoc. Ing. Elec. Inst. Electrotech. Montefiore, No. 2, 139-84(Mar.-Apr. 1964). (In French)

The control and safety systems of the 50-Mw (thermal), high-flux reactor are discussed in detail. Control circuits, instrumentation, measurement systems, monitoring systems, and emergency shutdown systems are covered. (D.C.W.)

36853 USE OF SMALL REACTORS IN BIOLOGY, MEDICINE, AND INDUSTRY. Alfons Thiel (Gutehoffnungshütte Sterkrade, Oberhausen, Ger.). p.83-90 of "Atomstrahlung in Medizin und Technik." Munich, Verlag Karl Thiemig KG, 1964. (In German)

Small reactors can be used in biology, medicine, and industry for the production of radioisotopes (principally short-lived), irradiation experiment, and activation analysis. Examples of each of these uses are discussed. The characteristics of the TRIGA reactors that make them suitable for this type of use are reviewed. (J.S.R.)

36854 METHODS AND EQUIPMENT FOR IRRADIATION TECHNIQUES AT THE GEESTHACHT RESEARCH REACTOR. Erich Fischer (Kernenergieverwertung in Schiffbau und Schiffahrt mbH, Hamburg). p.199-205 of "Atomstrahlung in Medizin und Technik." Munich, Verlag Karl Thiemig KG, 1964. (In German)

An insight is given of the purposes and methods of irradiation technology at the Geesthacht Research Reactor without giving a systematic survey. The irradiation devices are described under three groupings: mechanical devices for irradiation of large samples, instrumented irradiation capsules, and irradiation loops. (J.S.R.)

WASTE DISPOSAL AND PROCESSING

Refer also to abstracts 35762 and 35763.

36855 (CRIO-1194) RADIOACTIVE LIQUID WASTE HANDLING AND DISPOSAL AT CHALK RIVER. N. F. Murray (Atomic Energy of Canada Ltd. Chalk River Nuclear Labs., Chalk River, Ont.). Jan. 1964. 20p. (AECL-1975)

A description is given of the active liquid waste handling procedures and ultimate disposal methods used at the Chalk River Nuclear Laboratories. Experience of the past eight years, including estimates of the amounts of waste handled, is outlined. (auth)

36856 (IDO-14627) DEVELOPMENT OF A FLUIDIZED BED CALCINATION PROCESS FOR ALUMINUM NITRATE WASTES IN A TWO-FOOT-SQUARE PILOT PLANT CALCINER. PART IV. FINAL PROCESS STUDIES— RUNS 23 THROUGH 37. B. P. Brown, B. M. Legler, and L. T. Lakey (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). June 1964. Contract AT(10-1)-205. 194p.

Final process studies, comprising fifteen runs (Runs 23 through 37), were made on the calcination of aluminum nitrate wastes in a two-foot-square calciner to provide support data for the Idaho Chemical Processing Plant Waste Calcining Facility (WCF) and to study further the fluidized bed calcination process. For each run, the objectives, conditions, and results are given. Final testing of the feed nozzle selected for use in the WCF and demonstration of the control of the crystallinity of the product were major objectives of these studies. Factors affecting the generation of elutriatable solids from the calciner were determined. Properties of the fines elutriated from the calciner and additional product properties were also determined. New experimental techniques were developed for control of particle size and for measurement of the rate of growth of particles. (auth)

36857 (TID-3311(Suppl.1) RADIOACTIVE WASTE PROCESSING AND DISPOSAL. An Annotated Bibliography of Selected Literature. Theodore F. Davis and Hugh E. Voress, comps. (Division of Technical Information Extension, AEC). June 1964. 194p.

These selected 989 annotated references supplement TID-3311, TID-3555, and TID-3555(Suppl. 1). Unclassified report and journal literature from June 1962 through January 1964 is covered. The references have been subject-arranged (general, gaseous wastes, liquid wastes, solid wastes, and miscellaneous) and provided with numerous cross references. Author, corporate author, and report number-availability indexes are included. (auth)

36858 EFFICACY OF ACTIVE MUD IN THE DECONTAMINATION OF RADIOACTIVE WASTE MATERIAL. G. Branca and S. Gagliardi. Igiene Sanita Pubblica (Rome), 19: 496-519(1963).

Research was carried out with the object of ascertaining the efficiency of active mud processes for the decontamination of waste products containing radioactivity. The biological systems used for the purification of domestic waste products, including the process with active mud, are not specifically suitable for the treatment of contaminated waters. Nevertheless these offer to a community that possesses purifying plants a certain degree of protection in those cases in which the waste products are contaminated accidentally. The active mud process is preferred because it has the advantage of making possible the addition to the waste products of coagulant reagents which increase the decontamination. The radioisotopes studied were: ^{137}Cs, ^{90}Sr, ^{106}Ru, ^{131}I and ^{32}P. The results obtained are presented in graphs and tables. (Excerpta Med., Sect. 23, 1: No. 7, July 1964)

36859 HEAT GENERATION BY RADIOACTIVE WASTES. E. F. Gloyna (Univ. of Texas, Austin), H. J. Longley, and C. W. Christenson. J. Sanit. Eng. Div., Am. Soc. Civil Engrs., 90: 43-66(Feb. 1964).

Generalized numerical and analytical methods were developed for estimating temperatures resulting from the storage of high-level wastes. Parametric relations were considered; and solutions for the packed-bed, multi-region, variable-geometry, and variable-effective thermal conductivity systems were obtained. Solutions of the heat equation in one space dimension were obtained for plane, cylindrical, and spherical geometries. Three computer codes were developed, tested for accuracy, and compared. The codes represent three approximations to the actual physical situation. An auxiliary code was written to provide an estimate of the waste that could be put into a cavity when a maximum permissible temperature is specified. The accuracy of the solutions depends chiefly on the values of the input data and the variations of the parameters affecting the finite mesh and boundary conditions. The size of storage sites, the concentration of wastes, and the age of wastes have the greatest effect on the magnitude of the temperature. (Publ. Health Eng. Abstr.)

36860 THE EVALUATION AND CONTROL OF THE RADIOACTIVE WASTE DISPOSAL TO SEA. Yoshio Hiyama (Tokyo Univ.). Nippon Genshiryoku Gakkaishi, 6: 406-11(July 1964). (In Japanese)

Types of hazards, groups of people to be considered, and the basic dose effect relation to evaluate the size of hazards are discussed. As the methods of disposal permissible at present, two ways are mentioned. One is the high radioactive material kept in unbreakable container can be disposed to the bottom of some depth. The other is the diluted low level waste that can be continuously poured into some area where dilution is going on continuously. Any other means other than these two, for example a bay where insufficient exchange of water occurs and where the surface water is usually productive, is not suitable for disposal. The concentration factor obtained both by the experiment using tracers and by chemical analysis of the stable element in sea water and organisms differs greatly according to the radio-nuclide and the taxonomical position of the organisms. The rate of uptake differs depending on the chemical form, radio-nuclide, temperature of sea water, growth stage, and the kind of organism. Ways to evaluate Maximum Permissible Concentration of sea water are described. Three steps of food chain, radioisotope concentration in sea water, index organisms, and marine food products on the market should be monitored constantly. For this purpose proposal of International Index Organisms have been made. A table of concentration factors determined is included. (auth)

36861 DEZAKTIVALITSIYA SBROSNYKH VOD RADIOKHIMICHESKIKH LABORATORII I EKSPERIMENTAL'NYKH ATOMNYKH REAKTOROV. (Decontamination of Waste Liquid from Radiochemical Laboratories and Experimental

Atomic Reactors). A. A. Khonikevich. Moscow, Atomizdat, 1964. 110p.

A review is given of problems in decontaminating weakly active waste liquids. The effects of chemical and radiochemical compositions on the efficiency of decontamination are discussed. Installations and devices used for decontamination and their technological design and performance are also considered. 107 references. (R.V.J.)

36862 PROCESS FOR THE PRODUCTION OF SOLID PRODUCTS CONTAINING RADIOACTIVE WASTE MATERIAL AND PRODUCTS OBTAINED BY THIS PROCESS. Guy Lefillatre, Jean Rodier, and Jean Scheidhauer (to Commissariat à l'Energie Atomique). U. S. Patent 3,142,648. July 28, 1964. Priority date Dec. 6, 1961, France.

A process is given for solidifying aqueous radioactive muds. The process comprises mixing the mud with a fluidified agent to form two phases, eliminating the water, distilling off the residual water from the bitumen, and pouring the bitumen to form solid plastic blocks. The bitumen may be fluidified by high temperature or a nonpolar solvent, and the wetting agent may comprise 1 to 20% by weight of the butumen. Two examples of the process are given in which potassium and calcium naphthenates were used as wetting agents. (D.L.C.)

GENERAL AND MISCELLANEOUS

36863 (BNL-7167) CELL PROLIFERATION IN GERMINAL CENTERS OF THE RAT SPLEEN. T. M. Fliedner, M. Kesse, E. P. Cronkite, and J. S. Robertson (Brookhaven National Lab., Upton, N. Y.). [1963]. Contract [AT(30-2)-Gen-16]. 41p. (CONF-149-2)

From Conference on Leukopoiesis in Health and Disease, New York, May 1963.

Data are presented from a study on time parameters of cell renewal in the lymphatic nodules of the rat spleen. Tritiated thymidine was administered to label all cells that were in DNA synthesis at the time of the injection. Changes of the labeling indices and of the intensity of labeling were studied by serial killing of animals after labeling and then studying the sequence of events in the spleens by autoradiography. Results indicate that mantle zone cells represent part of a storage pool if lymphocytes with a rather slow rate of proliferation under steady-state conditions. 51 references. (C.H.)

36864 (BNL-7176) TEMPORAL SEPARATION OF SURGERY FROM OBSERVATION IN THE STUDY OF BILIARY PHYSIOLOGY. P. S. Papavasiliou, S. T. Miller, J. K. Marshall-Gulibon, and G. C. Cotzias (Brookhaven National Lab., Upton, N. Y.). [July 3, 1963]. Contract [AT(30-2)-Gen-16]. 11p.

Since surgical stress affects the regulation of body constitution by the liver and the pancreas, the necessity is stated for temporal separation of surgery from observation in physiological studies of the intra-abdominal tributaries to the gastrointestinal tract. Two methods for such temporal separation are described. The first permits willful, repeated, reproducible obstruction and release of the common bile duct. The second allows repeated exteriorization and reconstitution of bile flow. Both apply to the non-stressed, unanesthetized nondepleted rat. (auth)

36865 (BNL-7192) THE THEORY AND APPLICATIONS OF ACCUMULATION FUNCTIONS. S. Raman (Brookhaven National Lab., Upton, N. Y.). [196?]. Contract [AT(30-2)-Gen-16]. 30p.

The theory of accumulation functions is discussed both from the point of view of multiple Patterson superpositions as well as the Fourier transform theory. The latter leads to a Fourier synthesis representation of the accumulation of product functions, thereby making the calculations easier. Properties of the various types of accumulation of minima and accumulation of product functions are described and structure determining methods based on accumulation of product functions are described and structure determining methods based on accumulation functions are proposed. The conclusions were verified on a model structure. Also, it is pointed out how improved heavy-atom methods can be developed by suppressing, through the use of the MA-function, the light atom to light atom vectors from the Patterson of a complicated heavy-atom structure. A powerful method for the identification and elimination of incorrect atoms in the input-set of a Fourier synthesis calculation is suggested. (auth)

36866 (BNL-7213) REGULATION OF GENE ACTION. Geoffrey Zubay (Brookhaven National Lab., Upton, N. Y.). [1963]. Contract [AT(30-2)-Gen-16]. 17p.

Specificity considerations lead to the prediction that the class of compounds known as gene repressors are proteins. It is postulated that the binding of the repressor modifies the DNA configuration to make it suitable for the initiation of RNA synthesis. Propagation of RNA synthesis depends upon the subsequent release of the repressor by the inducer. Stimulation of antibody synthesis by antigen is explained under the assumption that the antibody represses its own synthesis and the antigen induces it. It seems likely that differentiated cells use similar gene regulating apparatus. (auth)

36867 (BNL-7226) PATHWAYS OF RESPIRATION IN PLANT TUMORS. K. J. Scott, J. S. Craigie, and Robert M. Smillie (Brookhaven National Lab., Upton, N. Y. and National Research Council of Canada. Atlantic Regional Lab., Halifax, N. S.). [1963]. Contract [AT(30-2)-Gen-16]. 22p.

The activities of enzymes of the hexose monophosphate shunt, glycolysis, and the tricarboxylic acid cycle were assayed in homogenates of normal and tumor tissues of red beet roots. Per mg protein, the activities of phosphohexoisomerase, phosphofructokinase, and 3-phosphoglycerate kinase were slightly lower in tumor tissues. The activities of the remainder of the glycolytic and tricarboxylic acid cycle enzymes were similar in both types of tissues. Glucose-6-phosphate dehydrogenase, 6-phosphogluconate dehydrogenase, and phosphoriboisomerase activities were increased 2- to 3-fold in tumors, per mg protein. Transaldolase and transketolase activities were similar in both types of tissue. In other experiments, glucose specifically labeled in the 1, 2, or 6 carbon position was offered to slices of normal and tumor tissues, and the C_6/C_1 ratios determined. C_6/C_1 ratios less than unity were observed in both tissue types indicating that the hexose monophosphate shunt is operative in glucose metabolism. These results are discussed in relation to respiratory pathways in both tissues and it is suggested that tumors have a greater potential to oxidative decarboxylate hexoses to ribose 5-phosphate than normal tissues. (auth)

36868 (BNL-7246) IMPROVED GROWTH OF ETIOLATED PISUM SEEDLINGS FOR BIOASSAYS BY THE USE OF A COMPLETE CHELATED NUTRIENT SOLUTION. William S. Hillman (Brookhaven National Lab., Upton, N. Y.) and Masaki Furuya (Harvard Univ., Cambridge, Mass. Biological Labs.). [1962]. Contract [AT(30-2)-Gen-16]. 12p.

The use of a dilute, chelated, complete nutrient solution (0.1 or 0.125 X Hutner's medium) with vermiculite greatly increased vigor, uniformity, and day-to-day consistency of growth in etiolated Pisum seedlings, as usually grown for bioassays. The common use of water for this purpose, supplying neither nutrients nor buffering capacity for variations in possibly toxic ions, is probably partly responsible for the difficulties encountered in many laboratories in consistently growing these plants. (auth)

36869 (BNL-7259) CRYSTAL STRUCTURE OF POTASSIUM ACID TELLURATE TRIHYDRATE. S. Raman (Brookhaven National Lab., Upton, N. Y.). [1962]. Contract [AT(30-2)-Gen-16]. 19p.

The crystal structure of $KHTeO_4 \cdot 3H_2O$ belonging to the monoclinic space group $P2_1/c$ with 4 molecules per unit cell of parameters a = 8.26, b = 6.20 and c = 12.83 A, and $\beta = 108°$ has been solved by Patterson and heavy atom Fourier methods. The interesting facts about this study, which is probably the first detailed study of a tellurate,

are 1) the octahedral oxygen environment of the Te atom, 2) the 12-fold oxygen neighborhood of the K-atom, and 3) the bond distances and angles around the Te atom. Also, the correct chemical composition, not known in the beginning, was arrived at through the x-ray determination and was confirmed by chemical analysis. (auth)

36870 (BNL-7260) EVALUATION OF MITOTIC TIME IN VIVO, USING TRITIATED THYMIDINE AS A CELL MARKER: SUCCESSIVE LABELING WITH TIME OF SEPARATE MITOTIC PHASES. N. Odartchenko, H. Cottier, L. E. Feinendegen, and V. P. Bond (Brookhaven National Lab., Upton, N. Y.). [Aug. 6, 1963]. Contract [AT(30-2)-Gen-16]. 25p.

Following a single injection of tritiated thymidine in dogs, a reproducible type of curve was obtained for the time sequence of the progression of labeled cells in separate mitotic phases, as observed on serial bone marrow aspirations. The duration of mitosis in erythroblasts at an advanced stage of maturation toward erythrocytes was shown to be of the order of 30 to 40 minutes for at least 50% of the cells undergoing division at that stage. Mitotic time did not appear to vary markedly for the remaining 50%. The variability in the duration of the premitotic synthetic gap appeared more pronounced than the variability in mitotic time. The values obtained were shown to not be influenced by morphological criteria used to register cells in mitosis. No effects of incorporated tritiated thymidine susceptible to appreciably modify the results were detected. (auth)

36871 (BNL-7281) ON THE CRYSTAL CHEMISTRY OF SALT HYDRATES. II. A NEUTRON DIFFRACTION STUDY OF $MgSO_4 \cdot 4H_2O$. Werner H. Baur (Brookhaven National Lab., Upton, N. Y.). [1962]. Contract [AT(30-2)-Gen-16]. 25p.

The crystal structure of $MgSO_4 \cdot 4H_2O$ has been refined using single crystal neutron diffraction data for the three main zones. The hydrogen positions which were found are essentially those which have been deduced from x-ray data in an earlier investigation. The mean value of the O_w-H bond lengths is 0.97 Å. The O_w-H-O bonds are bent considerably. One hydrogen atom does not participate in hydrogen bonding, as can be concluded from the geometry of its surroundings and its thermal motion. (auth)

36872 (BNL-7292) ADENOSINETRIPHOSPHATE CLEAVAGE DURING THE G-ACTIN TO F-ACTIN TRANSFORMATION AND THE BINDING OF ADENOSINEDIPHOSPHATE TO F-ACTIN. M. Barany, D. E. Koshland, Jr., S. S. Springhorn, F. Finkelman, and T. Theratil-Anthony (Institute for Muscle Disease, Inc., New York and Brookhaven National Lab., Upton, N. Y.). [196?]. Contract [AT(30-2)-Gen-16]. 16p.

Polymerization of actin in $H_2{}^{18}O$ showed that the nucleophilic attack during polymerization is on the terminal phosphorus atom of ATP. This together with previous data essentially eliminates the possible existence of a covalent bond in the actin-ADP complex. The tightness of binding of ADP in F-actin is, therefore, probably a function of the conformation of the protein. (auth)

36873 (BNL-7297) THE REARRANGEMENT OF DIPHENYL. Hans Wynberg and A. P. Wolf (Brookhaven National Lab., Upton, N. Y.). [1963]. Contract [AT(30-2)-Gen-16]. 5p.

The intramolecular rearrangement of the benzene rings in diphenyl was studied. When diphenyl-1,1'-^{14}C was heated with 10 mole % $AlCl_3$ and 1 mole % H_2O, the radioactivity became randomly distributed. Similar results were obtained in benzene solution; the benzene did not participate in the reaction. Possible mechanisms for the reaction are discussed. (D.L.C.)

36874 (BNL-7299) ON THE GENERATION OF AN ARBITRARILY AUTOCORRELATED SEQUENCE OF RANDOM VARIABLES FROM A SEQUENCE OF INDEPENDENT RANDOM NUMBERS. John H. Halton (Colorado. Univ., Boulder and Brookhaven National Lab., Upton, N. Y.). [1963]. Contract [AT(30-2)-Gen-16]. 18p.

Explicit additive solutions, implicit additive solutions, truncated autocorrelation, and a stochastic recurrence-relation are considered for a sequence of random variables ζ_n that have prescribed mean values μ_n and variances σ_n^2, with a given autocorrelation ρ_t. (R.E.U.)

36875 (BNL-7318) EFFECTS OF CHRONIC EXCESS SALT INGESTION: POSSIBLE IMPLICATIONS OF THE ACCELERATED INDUCTION OF EXPERIMENTAL HYPERTENSION BY 2,4-DINITROPHENOL. Lewis K. Dahl, Martha Heine, and Lorraine Tassinari (Brookhaven National Lab., Upton, N. Y.). [1962]. Contract [AT(30-2)-Gen-16]. 23p.

The effects of chronic excess salt ingestion on the induction of hypertension were studied in rats. Results are reported from studies that indicate that 2,4-dinitrophenol can rapidly induce hypertension in salt-fed rats. Implications of the findings to the pathogenesis of hypertension in man are discussed. (C.H.)

36876 (BNL-7335) ON THE CRYSTAL CHEMISTRY OF SALT HYDRATES. III. THE DETERMINATION OF THE CRYSTAL STRUCTURE OF $FeSO_4 \cdot 7H_2O$ (MELANTERITE). Werner H. Baur (Göttingen, Germany. Universität. Mineralogisch-Kristallographisches Institut and Brookhaven National Lab., Upton, N. Y.). [1962]. Contract [AT(30-2)-Gen-16]. 27p.

$FeSO_4 \cdot 7H_2O$ crystallizes in space group $P2_1/c$ with a = 14.072, b = 6.503, c = 11.041 Å, β = 105°34', Z = 4. The crystal structure was determined from Patterson and Fourier projections using F_{h0l} and F_{hk0} data. The refinement was done by the method of least squares employing 738 observed structure factors from the zones hk0, h0l, 0kl, h3l, and hkl. The final R value, including the contribution of the hydrogen atoms, is 4.5%. The Fe ions occupy special special positions and are surrounded octahedrally by six water molecules each. The six water oxygens form hydrogen bonds to the tetrahedral sulfate group and to the seventh water molecule which is not coordinated to Fe^{2+}. The mean bond length of $Fe-O_w$ is 2.12_4 Å, of S–O 1.47_4 Å and of O–H—O 2.82 Å. One of the Fe-coordinated water oxygens receives an "outward" hydrogen bond from the seventh water oxygen. The bond from Fe to this water oxygen is 2.19 Å and thus significantly longer than the mean $Fe-O_w$ bond length. (auth)

36877 (CONF-639-1) THE OUTGROWTH OF SPORES OF TYPE E CLOSTRIDIUM BOTULINUM IN LABORATORY CULTURE MEDIA BELOW 50°F. C. F. Schmidt, W. P. Segner, and J. K. Boltz (Continental Can Co., Inc., Chicago). [196?]. Contract AT(11-1)-1183. 17p.

From 24th Annual Meeting of the Institute of Food Technologists, Washington, D. C., May 1964.

Results are reported from a study of the behavior of Type E Clostridium botulinum in a variety of culture media at temperatures below 50°F. (C.H.)

36878 (CONF-639-2) OUTGROWTH OF SPORES OF TYPE E CLOSTRIDIUM BOTULINUM IN FISH HOMOG-

ENATES BELOW 50°F. W. P. Segner, J. K. Boltz, and C. F. Schmidt (Continental Can Co., Inc., Chicago). [1964]. Contract AT(11-1)-1183. 14p.

From 24th Annual Meeting of the Institute of Food Technologists, Washington, D. C., May 1964.

Results are reported from studies of factors that influence the outgrowth of spores of selected strains of Type E Clostridium botulinum in fish substrates at temperatures below 50°F. (C.H.)

36879 (CONF-640-1) EFFECT OF SODIUM CHLORIDE AND pH ON THE OUTGROWTH OF SPORES OF TYPE E CLOSTRIDIUM BOTULINUM AT OPTIMAL AND SUBOPTIMAL TEMPERATURES. W. P. Segner, C. F. Schmidt, and J. K. Boltz (Continental Can Co., Inc., Chicago). May 1, 1964. Contract AT(11-1)-1183. 13p.

From 24th Annual Meeting of the American Society for Microbiology, Washington, D. C., May 1964.

The maximal concentrations of salt and the minimal pH permitting outgrowth of spores of selected strains of Type E Clostridium botulinum were determined. Data are included on the interaction of low temperatures of incubation with various pH levels and with various salt concentrations as a means of extending outgrowth time. (C.H.)

36880 (CONF-641-1) THE BACTERIOLOGY OF TYPE E CLOSTRIDIUM BOTULINUM. C. F. Schmidt and W. P. Segner (Continental Can Co., Inc., Chicago). [1964]. Contract AT(11-1)-1183. 19p.

From 16th Annual Research Conference of the American Meat Institute Foundation, Chicago, Feb. 1964.

Data are presented on the growth and toxin formation of Type E Clostridium botulinum under various culture conditions and media. (C.H.)

36881 (COO-1148-86) POLAROGRAPHIC REDUCTION OF PYRIDINIUM ION IN PYRIDINE. APPLICATION TO THE DETERMINATION OF BRØNSTED AND LEWIS ACIDS. Michael S. Spritzer, Jose M. Costa, and Philip J. Elving (Michigan. Univ., Ann Arbor). July 15, 1964. Contract AT(11-1)-1148. 24p.

An investigation on the polarographic behavior of pyridinium ion in pyridine solution (lithium perchlorate as background electrolyte) showed a 1e diffusion-controlled reduction wave at the D.M.E., which is linearly proportional to concentration. The reduction involves attack on the pyridine ring, as contrasted to the nature of pyridinium ion reduction in aqueous solution. The 1e nature of the wave was established coulometrically, which indicates that the pyridinium ion can be also determined by direct coulometry. The pyridinium ion gives the same half-wave potential and diffusion current constant regardless of its source, which may be a pyridinium salt, a Brønsted acid of pK_a of less than 9 in water, or a Lewis acid such as an alkyl halide, which forms a quaternary salt with pyridine. Polyprotic acids give a multiple diffusion current constant. This behavior allows the determination of a large variety of inorganic and organic acids, as well as the determination of the total acidity of a sample. (P.C.H.)

36882 (HW-SA-3170) A NOTE ON MULTIPLYING BOOLEAN MATRICES. [PART] II. D. R. Comstock (General Electric Co. Hanford Atomic Products Operation, Richland Wash.). Aug. 19, 1963. Contract [AT(45-1)-1350]. 4p.

A method for determining A^{n-1}, where A is a Boolean matrix whose entries are zeros and ones and n is the order of the matrix, is described. (R.E.U.)

36883 (HW-SA-3193) ALGORITHM MONTE CARLO—HOTELLING. D. R. Comstock (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [Sept. 11, 1963]. Contract AT(45-1)-1350. 3p.

A transliteration of an existing program written in FORTRAN II for IBM 7090 is described that is used to calculate the approximate inverse of a given matrix by a Monte Carlo technique with further accuracy provided by Hotelling iteration. (R.E.U.)

36884 (LA-2696) ENTHALPY, DENSITY, AND COEFFICIENT OF THERMAL EXPANSION OF TNT. Howard H. Cady and William H. Rogers (Los Alamos Scientific Lab., N. Mex.). Apr. 8, 1962. Contract W-7405-eng-36. 16p.

The enthalpy of TNT (2,4,6-trinitrotoluene) relative to 0°C was found to be given by the following expressions where T is expressed in degrees centrigrade: $H-H_0$ cal/g (25° to mp) = $0.045 + 0.24625T + 4.205 \times 10^{-4}T^2$, $H-H_0$ cal/g (mp to 117°) = $12.450 + 0.450 + 0.45023T - 4.0091\ 10^{-4}T^2$. The density of molten TNT over the range 83–120°C was found to be given by: ρ (g/cc) = $1.5446 - 1.016 \times 10^{-3}T$ (°C). (auth)

36885 (LADC-5995) ENUMERATION OF LINEAR GRAPHS AND CONNECTED LINEAR GRAPHS UP TO P = 18 POINTS. M. L. Stein and P. R. Stein (Los Alamos Scientific Lab., N. Mex.). [1963]. Contract [W-7405-eng-36]. 75p.

The number of linear graphs $L_{p,k}$ and connected graphs $C_{p,k}$ with p points and k lines up to and including p = 18 was calculated using the MANIAC II computer. The theoretical basis of the enumeration is presented, and the method for obtaining the number of $C_{p,k}$ once the $L_{p,k}$ are known is outlined. Some practical aspects of the calculation and some asymptotic properties of the $L_{p,k}$ are discussed. (R.E.U.)

36886 (NAA-SR-9848) SIMPLIFIED FORMULAS AND CURVES FOR BELLOWS ANALYSIS. R. A. Winborne (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Aug. 1, 1964. Contract AT(11-1)-Gen-8. 39p.

Development is presented of (1) a digital computer program (based on an asymptotic solution of equations from small deflection theory of shells) for solution of problems relating to shallow shell-shaped welded bellows, and (2) associated curvature correction charts with four parameters on one sheet of regular coordinate graph paper. A design section, in simplified form, is included for solution of problems encountered in shell, convolute, and toroid-shaped bellows. (auth)

36887 (NP-14174(Vol.2)) SCIENTIFIC OBSERVATIONS ON THE EXPLOSION OF A 20 TON TNT CHARGE. VOLUME TWO. TRIPARTITE BLAST MEASUREMENTS. Suffield Report No. 203. (Canada. Suffield Experimental Station, Ralston, Alberta). Sept. 1, 1961. 259p.

Presented are air blast data obtained from the detonation of 20 tons of TNT. The air blast phenomena were recorded by both electronic transducers and recording system, and mechanical type self-recording gages. These measurements were made along a common blast line with instrumentation designed primarily for atomic tests. The results will be compared with similar measurements made by other participants along the same blast line for a cross-calibration of instrumentation. Analysis of the data shows that, whereas a system response time in the order of one to two milliseconds is not critical on atomic tests where the duration of the positive pressure pulse may be in the order of one second, it becomes less tolerable when mea-

suring a peak overpressure of greater than 15 psi with positive duration less than 50 milliseconds. (auth)

36888 (ORNL-P-149) COMPARISON OF THE THERMAL CONDUCTIVITY, ELECTRICAL RESISTIVITY, AND SEEBECK COEFFICIENT OF A HIGH-PURITY IRON AND ARMCO IRON TO 1000°C. J. P. Moore, W. Fulkerson, and D. L. McElroy (Oak Ridge National Lab., Tenn.). [1964]. Contract [W-7405-eng-26]. 20p. (CONF-638-1)

Addendum to ORNL-3556.

From National Physical Laboratory Conference on Thermal Conductivity, Teddington, Eng., July 1964.

The results of this study show Armco iron to be an excellent thermal conductivity standard and the temperature dependence of the thermal conductivity can be calculated to ±1.5% using electric resistivity measurements. The shape and magnitude of the temperature dependence of the total thermal conductivity of iron are controlled by the electronic contribution; this can be calculated from either the Wiedemann-Franz-Lorenz relation or the Backlund relation. The total thermal conductivity of iron has (a) a change of slope at 436°C which possibly is related to a minimum in the Seebeck coefficient at this temperature; (b) a minimum at 780°C which is associated with the change in magnetic properties; and (c) a 4 to 7% drop at the α-γ transformation which is not predicted by the electric resistivity measurements but which is due to a 30 to 50% decrease in the lattice portion of the thermal conductivity. Current theoretical treatments of the total thermal conductivity of iron are not consistent in yielding a linear temperature dependence of the thermal resistance due to the lattice portion. Furthermore, the effect of impurities on the electric resistivity is not a simple additive amount independent of temperature. The Seebeck coefficient of iron is sensitive to impurity content below 550°C and increases with purity. The Seebeck coefficient exhibits a pronounced minimum near 430°C and undergoes a 43% decrease at the α-γ transformation. The thermophysical property measurements on the two irons at 100°C can be used to predict the following property values for an iron free of impurities: $\underline{k}$, 0.701 w °K^{-1}cm^{-1}; ρ, 14.62 μohm-cm; and S, 18.46 μv/°K. (auth)

36889 (SC-DR-64-978) MOLECULAR WEIGHTS OF MACROMOLECULES FROM VISCOSITY MEASUREMENTS. J. P. Burger (Sandia Lab., Albuquerque, N. Mex.). Aug. 1964. Contract AT(29-1)-789. 8p.

The intrinsic viscosities [N] of a group of macromolecules (polysiloxanes) have been determined in benzene solution, and a relationship between these values and the viscosity-average molecular weights $\overline{M}_v$ has been established with the use of the Mark-Houwink equation: $[N] = K\overline{M}_v^a$. (auth)

36890 (SCL-R-64-68) COMPUTER CONTROL OF ENGINEERING DRAWING, SCHEDULING AND PROCUREMENT DATA. Stanley J. Swihart (Sandia Corp., Albuquerque, N. Mex.). July 1964. Contract [AT(29-1)-789]. 34p. (CONF-618-1)

From IBM Aerospace Data Utilization Workshop Meeting, Los Angeles, Apr. 1964.

A computer method is described for updating and maintaining a file of parts list and list of material data. Provision is made for high-speed retrieval of any information contained in the system. The application of these same concepts to scheduling and procurement activity is proposed. Tape and disk files for this application are compared. The generalized disk software package used to program all the systems is described. (auth)

36891 (TID-3724) BIBLIOGRAPHIES OF ATOMIC ENERGY LITERATURE. Issued or in Progress During the Period, June–July 1964. (Division of Technical Information Extension, AEC). 18p.

A total of 107 bibliographies is listed. arranged according to issuing organization. Subject, author, and report number and availability indexes are included. (D.L.C.)

36892 (TID-7695(p.75-98)) CALCULATION OF EXPLOSION-PRODUCED CRATERS. J. B. Knox and R. W. Terhune (California. Univ., Livermore. Lawrence Radiation Lab.).

This study develops a simple, two-dimensional model of cratering physics for high-explosive sources in alluvium during the gas acceleration phase of excavation. The model requires knowledge of the earth's free-surface topography and motion at the time the surface gas acceleration begins (t_G), and the cavity pressure and volume. At t_G, the overburden material, that material between the cavity and the earth's free surface, is assumed to be a homogeneous, incompressible, viscous fluid. At this time the cavity is approximated by two hemispheres: (a) the radius of the lower hemisphere is calculated by a one-dimensional, hydrodynamic, plastic-elastic model (SOC), and (b) the radius of the upper hemisphere is calculated from mass conservation of the overburden material. In the model the upper hemispheric surface is subdivided into elemental surface areas, and mass zones are defined which subtend these elemental surface areas. By applying Newton's second law with a simple frictional force (calibrated on the Scooter event) to each mass element, and by assuming that the cavity gas behaves adiabatically, the cavity evolution, mound development, and the formation of the lip through up-thrust are numerically simulated. With the development of a calibrated, numerical simulation model of excavation processes during the surface gas acceleration phase, the capability of the model to estimate the apparent crater radii and depths for ½-kt, high-explosive (H.E.) sources at various emplacement depths is explored. Assuming a reasonable angle of repose for alluvium, 45°, crater radii for scaled depths of burst from about 10 to 65 m are predicted. These estimated apparent crater radii compare very favorably with the observed crater radii (Nordyke, 1961) for H. E. in alluvium. Further, the crater depths, for certain types of craters, are also reasonably predicted. (auth)

36893 (TID-7695(p.99-108)) ENGINEERING PROPERTIES OF EXPLOSION-PRODUCED CRATERS. W. C. Sherman, Jr., and W. E. Strohm, Jr. (Waterways Experiment Station, Vicksburg, Miss.).

The study of the engineering properties of nuclear-explosion-produced craters has thus far been limited primarily to the Sedan crater in desert alluvium and the Danny Boy crater in basalt. Extensive preshot and postshot field and laboratory investigations have been made to evaluate the preshot engineering properties of the media and the changes which occur in these properties as a result of the explosions. In addition to changes in basic engineering properties, such as density and shear strength, large-scale effects such as strata distortion, displacements, and fracturing in the cratered media have been investigated. Results of the studies of the Sedan and Danny Boy craters are presented. The nature and characteristics of the fallback materials and disturbed materials beyond the crater are presented. Various engineering problems associated with the use of explosion-produced craters are outlined and the limitations imposed on the use of cratering for excavations because of the scarcity of empirical data are discussed. (auth)

36894 (TID-7695(p.169-80)) AIR BLAST FROM CRATERING EXPLOSIONS. Jack W. Reed (Sandia Lab., Albuquerque, N. Mex.).

Shock wave overpressure versus distance relations and scaling laws for spherical explosions in air are reviewed. For cratering bursts a modified source wave is proposed, with a strong wave shot upward and a reduced wave emitted horizontally along the ground. Some energy originally directed upward is diffracted into horizontal propagation so that at large distances there appears to be less relative amplitude attenuation than is observed close-in. Amplitude attenuation increases with scaled depth of burst, varies with certain material characteristics around a burst, and appears to decrease with increased yield. Results from Sedan, a 100-kiloton explosion near optimum depth for cratering in desert alluvium, showed that blast pressure amplitudes were about 20 percent as large as would have been expected from the same yield but burst in free air. Atmospheric temperatures and winds may cause refractive focusing of blast waves and greatly extend the normal range of light damages to windows, plaster, etc. Surface temperature inversions may enhance blast pressures for 20 to 30 miles, jet-stream winds may focus waves out to 100 miles and ozonosphere conditions at 100- to 150,000-feet altitudes may cause light damage several hundred miles from megatonclass cratering explosions. Relations between small overpressures and nuisance damages which they may cause are not clear, but some large windows have been reported broken with as little as 0.03-psi overpressures. The noise may be audible or even startling with 0.002-psi overpressure, and depends on shape of the pressure-time trace and wave frequency. (auth)

36895 (TID-7695(p.335-54)) EXPLOSIVELY CREATED HARBORS. John D. Isaacs (California. Univ., La Jolla. School of Oceanography).

The characteristics of natural explosively or volcanically created harbors are compared with the common estaurine harbors. It is held that such harbors are immune to many of the ills afflicting estuarine harbors. Some unique harbors of other origins are also discussed. Harbor-imposed limitations on ocean-going vessels are considered, and the implications of deeper harbors to transportation is discussed. Need for new harbors is related to fishing, export, and haven. The rationale and plans for a resurvey of the Bikini Crater and environs are presented. (auth)

36896 (TID-19539) WATER CONTENT OF MIXED LOADED $Ba^{++}-H^{+}$ RESINS. (Colorado. Univ., Boulder). [Sept. 1963]. Contract [AT(11-1)-499]. 7p.

A volume of glass beads was centrifuged against an equal volume of resin beads in order to establish the amount of external water retained by a volume of uniformly sized particles centrifuged at a constant rpm and temperature. The resins were $Ba^{2+}-H^{+}$ loaded. (P.C.H.)

36897 (TID-20887) THE SEDIMENTATION OF MANGANESE IN THE OPEN OCEAN: A PROJECT IN FUNDAMENTAL RESEARCH. Progress Report. Peter J. Wangersky (Yale Univ., New Haven. Bingham Oceanographic Lab.). [1964]. Contract AT(30-1)-2882. 9p.

The statistical analysis of core samples from the sea floor, in an attempt to deduce the mechanisms for deposition of Mn in the open ocean, is described. The Mn distribution in the cores is factored into its components by chemical fractionation. The dependence of the concentrations of the components upon the depth in the core and the location from which the core was taken is analyzed. (T.F.H.)

36898 (UCRL-7186) STRESS ANALYSIS OF AN OCTAGONAL-SHAPED ROTATING DISK. Maurice Zaslawsky (California. Univ., Livermore. Lawrence Radiation Lab.). Aug. 1, 1963. Contract W-7405-eng-48. 17p. (CONF-267-1)

From American Mathematical Society Annual Meeting, Cleveland, Nov. 1963.

A mathematical elastic solution is presented for determining the normal stresses in an octagonal-shaped rotating disk, a plane stress problem. The method of Muskhelishvili is used, where the normal stresses $\tau_{\alpha\beta}$ are broken up into two parts, $\tau^{(0)}_{\alpha\beta}$ and $\tau^{(1)}_{\alpha\beta}$, the former independent of the boundary condition, the latter dependent. The boundary-dependent stress $\tau^{(1)}_{\alpha\beta}$ is then related to the stress functions. Using the Schwarz-Christoffel Transformation, $\tau^{(1)}_{\alpha\beta}$ can then be determined, since the solution for a circular rotating disk is known. (auth)

36899 (UCRL-10768) UNSTABLE SOLID ALLOTROPES OF SULFUR. Beat Meyer (California. Univ., Berkeley. Lawrence Radiation Lab.). Aug. 1963. Contract W-7405-eng-48. 81p.

A review was made on the allotropic forms in which elemental sulfur has been observed below 30°C. The nomenclature, purification, preparation, and many properties of 33 molecules and modifications are discussed. 306 references are included. (P.C.H.)

36900 (UCRL-10791) ACTIVATED COMPLEX THEORY APPLIED TO THE THERMAL DECOMPOSITION OF SOLIDS. Robert D. Shannon (California. Univ., Berkeley. Lawrence Radiation Lab. and California. Univ., Berkeley). July 1963. Contract W-7405-eng-48. 26p.

The Polanyi-Wigner expression, generally used to predict order of magnitude values of rate constants for surface reactions, was applied to twenty-nine thermal decompositions. In the majority of cases agreement was poor. Rates of thermal decomposition of calcite and magnesite were then analyzed using activated complex theory in a manner similar to that already adapted to the evaporation of sulfur and benzene. Using a model postulating rotation of the carbonate ion at the solid surface, order of magnitude agreement between experimental and theoretical reaction rates was obtained. Finally, those rates involving abnormally high frequency factors were considered using an adsorbed surface layer model. (auth)

36901 (UCRL-10957) THE DEFINITION OF TOPOTAXY. Robert D. Shannon and Ronald C. Rossi (California. Univ., Berkeley. Lawrence Radiation Lab.). Aug. 8, 1963. Contract W-7405-eng-48. 7p.

The definition of topotaxy is discussed, and a distinction is made between topotaxy and epitaxy. Topotaxy requires the transformation or conversion of the reactant crystal into a new oriented phase, whereas epitaxy refers to a second phase overgrowth oriented with respect to a substrate. (P.C.H.)

36902 (UCRL-10969) REFINEMENT OF THE CRYSTAL STRUCTURE OF MERCURIC SULFATE MONOHYDRATE. Lieselotte K. Templeton, David H. Templeton, and Allan Zalkin (California. Univ., Berkeley. Lawrence Radiation Lab. and California. Univ., Berkeley. Dept. of Chemistry). Aug. 1963. Contract W-7405-eng-48. 13p.

The crystal structure of $HgSO_4 \cdot H_2O$ was refined using three-dimensional x-ray-diffraction data obtained by direct counting. The space group is Pmen with $\underline{a}$ = 5.416, $\underline{b}$ = 8.964, $\underline{c}$ = 7.874 Å (each ±0.003 Å). Each Hg is surrounded by five oxygen atoms and a water molecule at the corners

of an irregular octahedron. The distances of these neighbors are 2.17 Å, 2.50 Å (twice), 2.51 Å (twice), and 2.24 Å (water molecule), each ±0.01 Å. A hydrogen bond of length 2.83 Å was identified, but no evidence was found for hydrogen bonding by the second hydrogen atom. (auth)

36903 (UCRL-10995) KINETIC STUDIES OF THE PHOTOSYNTHETIC CARBON REDUCTION CYCLE. J. A. Bassham (California. Univ., Berkeley. Lawrence Radiation Lab.). Aug. 1963. Contract W-7405-eng-48. 52p.

The reductive pentose phosphate cycle for photosynthetic carbon reduction is reviewed. New evidence for this carbon reduction pathway is presented based on the results of studies on the kinetics of the labeling of compounds in the living cell following the introduction of ^{14}C-labeled substrate and studies on the enzyme activity of soluble and particulate fractions isolated from broken photosynthetic cells. The probability of the operation in vivo of some organized system is discussed. 55 references. (C.H.)

36904 (UCRL-11019) WHOLE-BODY IRON LOSS IN NORMAL MAN MEASURED WITH A GAMMA SPECTROMETER. Hiroshi Saito, Thornton Sargent, III, Howard G. Parker, and John H. Lawrence (California. Univ., Berkeley. Lawrence Radiation Lab.). Sept. 17, 1963. Contract W-7405-eng-48. 20p.

Radioiron loss by twelve normal subjects was studied for 300 days with a whole-body counter after intravenous ^{59}Fe injection. Ten subjects' average loss rate was 0.030% per day or 0.89 mg per day, which was obtained by a careful analysis of geometry factors and by the supplemental data obtained from peripheral blood, stool, and urine. Radioiron loss in two subjects' stool and urine and that measured by the whole-body counter showed good agreement. From the analysis of stool data, it was concluded that normal man loses blood in the intestinal tract and this is the route of largest iron loss in man. It was found that the whole-body radioactivity curve enables us to measure the red cell life span. (auth)

36905 (UCRL-13063) ANALYSIS OF THIN SPHERICAL SHELLS UNDER STEADY-STATE ACCELERATIONS. J. F. Brotchie, J. Penzien, and E. P. Popov (California. Univ., Berkeley. Inst. of Engineering Research). Sept. 1959. For Univ. of California, Lawrence Radiation Lab., Livermore. Contracts [W-7405-eng-48] and UCX-2191. 79p.

An analysis is presented of moments, shears, deflections, and in-plane forces produced when an elastic shell is accelerated by a rigid spherical cavity. The acceleration is taken to be steady-state, and the initial clearance between shell and cavity is assumed to be relatively small. Friction, multiple shells, openings, and thermal stresses are treated as special cases. (D.L.C.)

36906 (UCRL-13067) LAWRENCE RADIATION LABORATORIES HIGH PRESSURE GAS STORAGE CONTAINER DEVELOPMENT PROGRAM. Final Report. P. L. Rice (Garrett Corp. AiResearch Mfg. Div., Los Angeles). Dec. 17, 1962. For Univ. of California, Lawrence Radiation Lab., [Livermore]. Contract [W-7405-eng-48]. 39p.

Fabrication procedures were developed for small (~2-in. dia) spherical high-pressure containers of steel and titanium with copper liners. It was demonstrated that shell halves of an outer vessel can be welded together without damage to the liner. The ultimate strength of the vessels was determined to be 34,000 psig for steel and 27,000 psig for titanium. Weld efficiencies of 100% were obtained. (D.L.C.)

36907 EURATOM INFORMATION. Vol. 2, No. 7, p.371-435, July 1964. (European Atomic Energy Community). 52p. $15.00 per yr. (Verlag Handelsblatt GmbH, Dusseldorf, Ger.).

A cumulative list of the EURATOM-United States contracts, EURATOM reports, publications, and patents is presented. The scope of programs contracted for during the report period is outlined. Technical progress is reviewed. Information is included on: biology and medicine, chemistry, engineering and equipment, mathematics and computers, metallurgy, physics, reactor technology, health and safety, geology, meteorology, and waste disposal and processing. (N.W.R.)

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This index contains entries for this period for all report literature and, in addition, for certain published literature items for which it is felt that a corporate approach is especially desirable, e.g., symposia, conference proceedings, and meetings.

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The phrase "Progress report" is abbreviated as "Prog. rpt.," permitting a more rapid and complete alphabetical arrangement of the titles without changing the location of the progress report titles in relation to the other titles.

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SUBJECT INDEX

Main entries in this index are generally specific materials, things, and processes. These are followed by modifiers that describe the properties of, and processes applied to, the main entries.

The number preceding the colon is the *NSA* volume number, and the number following is the abstract number. The designation (R) following the abstract number indicates that the abstract is of a progress report; (P) indicates a patent; and (T) indicates a translation. Abstracts for reports other than progress reports carry no letter designation. References to report numbers, where appropriate, are included after the abstract number of the citation. Published literature (journal article or book) is indentifiable by the absence of a report number.

General Indexing Style

The user should bear in mind that the ideas presented in the original literature, rather than key words, have been indexed. The indexers have tried to select what seemed the most probable and logical place to look for typical information. Since it is not possible to anticipate where a user would look for information, numerous cross references are included to assist him in his search.

Experience in using an index of this type will be the best guide in obtaining the desired information, and a consideration of synonymous or closely related terms will prove valuable.

Information must be so indexed as to be of the greatest use to the greatest number of users. This requires that a topic be indexed to headings that most specifically describe it and not ordinarily to the headings that describe its ultimate use, nor to the general class headings that include the specific headings. For example, information on the treatment of thyroid disease with I-131 would be indexed under Thyroid Diseases and under Iodine Isotopes I-131, but not necessarily under Radiotherapy. A study of the effects of x radiation on hair would be indexed under both X Radiation and Hair. However, the information would not be indexed under the experimental animal, e.g., Rats, unless the report discusses the effects on rat hair as compared with the effect on the hair of other animals.

The broad, general class headings are used only for general information or for comprehensive reports or articles.

Subject Heading Styles

Generally, the direct form of subject entry is used rather than inverted headings or, in some cases, subheadings; e.g., Amino Acids rather than Acids, amino; Helium Isotopes He-4 rather than Helium — isotopes He-4 or Helium — He-4 isotopes. Note, however, that in some cases modifying terms are used parenthetically in preference to a more direct type of entry which would result in the scattering of information. Organic compounds, however, are usually entered in the index in the inverted form so that substituted compounds can be listed near the parent compound; e.g., Benzene, Bromo- rather than Bromobenzene. In general, the style of nomenclature used is that of *Chemical Abstracts*, except that some items listed in that publication as subheadings are elevated to form part of the main heading; e.g., Butyric Acid, Methyl Ester rather than Butyric Acid — methyl ester.

Alphabetization

Main headings are arranged according to the widely accepted word-by-word alphabetic system. A parenthetic qualifier following a main heading is disregarded in alphabetizing unless there are two or more headings identical except for the parenthetic qualifier, in which case the qualifier determines the order. Headings involving Greek letters are arranged as if the names of the letters were spelled out, e.g., Mesons (π), Mesons (ξ).

Nomenclature of Inorganic Compounds

Inorganic compounds are indexed in the direct form, listing cations in the order of increasing valence in the case of polycationic salts of varying valence and in alphabetic order for polycationic salts in which all cations have the same valence; e.g., Sodium Aluminum Silicates and Potassium Sodium Sulfates.

Multicomponent Systems

Multicomponent alloys, except well-known trade names are indexed under each element in the alloy.

Example: Aluminum–Chromium Alloys are indexed

ALUMINUM ALLOYS
Al–Cr ...
CHROMIUM ALLOYS
Al–Cr ...

Well-known alloys such as Hastelloy are indexed directly with cross references under the element components. Multicomponent systems of elements are indexed similarly.

Example: Silicon–Tungsten Systems are indexed

SILICON SYSTEMS
Si–W ...
TUNGSTEN SYSTEMS
Si–W ...

Multicomponent systems of compounds are similarly indexed under the compound.

Physical States of Materials

In this subject index specification of the physical state of the material, if other than normal, is included in the modifying phrase.

Modifying Phrases (Subheadings)

Descriptive phrases (modifiers), rather than ordinary subheadings, are used under the main headings to give a better indication of the material covered in an abstract than would be possible with only a word or two whenever it appears that such information would be useful. Such phrases are written so that the idea considered most important is presented first, should a not-too-awkward expression result. However, when using this index, the reader is advised to scan all modifiers under a main heading to determine whether any abstracts in addition to the most obvious should be consulted for the desired information. Many of the modifiers are designed to be read in inverted order or to be read with the main heading inserted at the position of the comma in order to obtain a meaningful phrase; e.g., Uranium — allotropic transformation temperatures of, effect of cooling rate on is read "effect of cooling rate on allotropic transformation temperatures of uranium." In many cases, the prepositions have been omitted from such phrases provided no ambiguity results from the omission.

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AERE-R–	**(British)**	
3840	18-35442	Dep.(mc)
4198	18-35586	Dep.; $1.20(BIS; 6s. (HMSO)
4270	18-35443	Dep.; $0.30(BIS); 1s.9d. (HMSO)
4479	18-35868	Nucl. Instr. Methods, 29: 43-4(1964)
AFCRL–	**(Non-AEC)**	
63-584	18-36719	See PIBMRI-1202-63
63-943	18-36705	$2.60(OTS)
64-2	18-36039	$3.60(OTS)
64-107	18-36078	$6.60(OTS)
64-166	18-35830	$2.60(OTS)
64-242	18-36706	$2.60(OTS)
64-254	18-36707	
64-277	18-36708	$3.60(OTS)
64-293	18-36709	$2.60(OTS)
AFOSR–	**(Misc.)**	
J1553	18-36040	$2.60(OTS)
64-0301	18-36710	$1.10(OTS)
64-0353	18-36711	$6.60(OTS)
424	18-36178	$1.10(OTS)
AFSWC-TDR–	**(Non-AEC)**	
62-107	18-35831	$3.60(OTS)
AID-P–	**(Non-AEC)**	
64-13	18-36848	$1.10(OTS)
AMF-C–	**(Canadian)**	
63-1	18-35983	Dep.; $1.50(AECL)
ANL–		
6807	18-35682	Dep.; $1.75(OTS)
6835	18-35683	Dep.; $2.00(OTS)
6837	18-36802	Dep.; $0.50(OTS)
6862	18-35684	Dep.; $2.50(OTS)
6881	18-35832	Dep.; $0.50(OTS)
6912	18-36751	Dep.; $2.25(OTS)
APL-TDR–	**(Non-AEC)**	
64-19	18-35685	$1.25(OTS)
64-20	18-36041	$2.25(OTS)
ARL–	**(Non-AEC)**	
63-54	18-36712	$5.60(OTS)
64-79	18-36364	$1.10(OTS)
AROD–	**(Misc.)**	
795	18-35305	$0.50(OTS)
ASD-TDR–	**(Non-AEC)**	
63-476(Pt.II)	18-35491	OTS
AWRE-O–	**(British)**	
45/64	18-35952	Dep.(mc)
51/64	18-35984	Dep.(mc)

Report No.	Abstract No.	Availability
BM-RI–	(Misc.)	
6359	18-35953	Free(Bureau of Mines)
6498	18-35985	Free(Bureau of Mines)
6500	18-35492	Free(Bureau of Mines)
6506	18-35926	Free(Bureau of Mines)
BMI–	(Misc.)	
1675	18-35963	Dep.; $0.50(OTS)
1678	18-35924	Dep.; $0.75(OTS)
1679	18-36042	Dep.; $0.50(OTS)
1680	18-35925	Dep.; $0.75(OTS)
BNL–		
852	18-35833	Dep.; $0.50(OTS)
866	18-35927	Dep.; $1.50(OTS)
875	18-35928	Dep.; $0.75(OTS)
7167	18-36863	Dep.(mc); $4.60(fs), $1.43(mf) OTS Ann. N. Y. Acad. Sci., 113: 578-94(1964)
7176	18-36864	Dep.(mc); $1.60(fs), $0.80(mf) OTS
7180	18-36153	Dep.(mc); $1.60(fs), $0.80(mf) OTS Phys. Rev., 130: 1433(1963)
7191	18-36566	Dep.(mc); $1.60(fs), $0.80(mf) OTS
7192	18-36865	Dep.(mc); $2.60(fs), $1.10(mf) OTS
7200	18-35306	Dep.(mc); $1.60(fs), $0.80(mf) OTS
7213	18-36866	Dep.(mc); $1.60(fs), $0.80(mf) OTS
7214	18-36043	Dep.(mc); $1.10(fs), $0.80(mf) OTS
7219	18-35804	Dep.(mc); $1.10(fs), $0.80(mf) OTS
7226	18-36867	Dep.(mc); $2.60(fs), $0.86(mf) OTS Plant Physiol., 39: 323-7(1964)
7246	18-36868	Dep.(mc); $1.60(fs), $0.80(mf) OTS
7259	18-36869	Dep.(mc); $1.60(fs), $0.80(mf) OTS Inorg. Chem., 3: 634-8(1964)
7260	18-36870	Dep.(mc); $2.60(fs), $0.95(mf) OTS
7271	18-35307	Dep.(mc); $3.60(fs), $1.16(mf) OTS
7278	18-35493	Dep.(mc); $1.10(fs), $0.80(mf) OTS
7281	18-36871	Dep.(mc); $2.60(fs), $0.95(mf) OTS
7282	18-35834	Dep.(mc); $2.60(fs), $0.98(mf) OTS
7283	18-35835	Dep.(mc); $1.10(fs), $0.80(mf) OTS Rev. Sci. Instr., 35: 130-2(1964)
7289	18-35494	Dep.(mc); $2.60(fs), $0.86(mf) OTS J. Phys. Chem., 68: 174-80(1964)
7290	18-35495	Dep.(mc); $1.60(fs), $0.80(mf) OTS
7292	18-36872	Dep.(mc); $1.10(fs), $0.80(mf) OTS J. Biol. Chem., 230: 1917-19(1964)
7297	18-36873	Dep.(mc); $1.10(fs), $0.80(mf) OTS J. Am. Chem. Soc., 85: 3308(1963)
7299	18-36874	Dep.(mc); $1.60(fs), $0.80(mf) OTS
7307	18-35496	Dep.(mc); $1.10(fs), $0.80(mf) OTS Science, 141: 1171(1963)
7316	18-35308	Dep.(mc); $1.60(fs), $0.80(mf) OTS Proc. Natl. Acad. Sci., 50: 855-60(1963)
7318	18-36875	Dep.(mc); $2.60(fs), $0.89(mf) OTS
7329	18-35714	Dep.(mc); $1.10(fs), $0.80(mf) OTS
7335	18-36876	Dep.(mc); $2.60(fs), $1.01(mf) OTS
7370	18-35335	Blood, 24: 241-53(1964)
7429	18-36003	J. Am. Ceram. Soc., 47: 390-4(1964)
7535	18-35372	Radiation Res., 22: 730-4(1964)
7617	18-36006	J. Inorg. Nucl. Chem., 26: 1456-8(1964)
7791	18-35613	J. Phys. Chem., 68: 2184-9(1964)
7797	18-35550	J. Phys. Chem., 68: 2179-83(1964)
7986	18-35560	Phys. Rev., 135: A1767-70(1964)
7998	18-35686	Dep.(mc); $1.60(fs), $0.80(mf) OTS
8010	18-35309	Dep.(mc); $6.60(fs), $2.21(mf) OTS
8025	18-36331	Phys. Rev., 135: B1430-6(1964)
8213	18-36110	Dep.(mc); $1.60(fs), $0.80(mf) OTS
8246	18-35587	Dep.(mc); $1.10(fs), $0.80(mf) OTS
BRL–	(Misc.)	
1237	18-35703	$4.60(OTS)
BSR–	(Non-AEC)	
847	18-35805	$1.60(OTS)
CAPE–		
573	18-35895	EM
1045	18-36177	EM
1105	18-35651	EM
1109	18-35652	EM
CEND–	(Misc.)	
3336-218	18-36044	Dep.(mc); $2.60(fs), $1.07(mf) OTS
CONF-47–	18-35270	(Conference Deutsches Atomforum Atomstrahlung In Medizin Und Technik, Munich, Jan. 1963)
CONF-136–	18-35727	(Symposium on the National Environment, Houston, Texas, Apr. 1963)
CONF-138–		(11th Detroit ANACHEM Conference, Detroit, Oct. 1963)
2	18-35490	ORINS. Gmelin, AED-CONF-63-199-3
CONF-149–		(Conference on Leukopoiesis in Health and Disease, New York, May 1963)
2	18-36863	See BNL-7167
CONF-178–		(European Atomic Energy Society's Symposium on Fuel Cycles for Power Reactors, Baden-Baden, Germany, Sept. 1963)
3	18-36804	See DL-58
CONF-179–		(American Chemical Society Radionuclidic Exchange on Soils, Minerals, and Resins, Philadelphia, Apr. 1964)
7	18-35697	ORINS. Gmelin, AED-CONF-64-033-12
9	18-35906	ORINS. Gmelin, AED-CONF-64-033-18
CONF-267–		(American Mathematical Society Annual Meeting, Cleveland, Nov. 1963)
1	18-36898	See UCRL-7186
CONF-285–		(7th Conference on Analytical Chemistry in Nuclear Technology, Gatlinburg, Tenn., Oct. 1963)
8	18-35449	See LADC-5830
CONF-446–		(American Nuclear Society 10th Annual Meeting, Philadelphia, June 1964)
10	18-36567	Dep.(mc); $1.60(fs), $0.80(mf) OTS
11	18-36559	See WAPD-T-1681
CONF-448–		(IAEA Symposium of the Assessment of Radioactive Body Burdens in Man, Heidelberg, Ger., May 1964)
16	18-35406	ORINS
17	18-35301	ORINS
18	18-35489	ORINS
19	18-35407	ORINS
20	18-35300	ORINS
CONF-452–		(American Physical Society, Washington, D. C., Apr. 1964)
43	18-36551	See GA-5373
CONF-453–		(IAEA Symposium on Medical Radioisotope Scanning, Athens, Apr. 1964)
7	18-35896	ORINS
8	18-35897	ORINS
9	18-35433	ORINS
11	18-35434	ORINS
12	18-35435	ORINS
13	18-35436	ORINS
CONF-456–		(18th Annual Symposium on Fundamental Cancer Research and Cellular Radiation Biology, Houston, Tex., Mar. 1964)
4	18-35437	ORINS. Gmelin, AED-CONF-64-034-2
CONF-498–		(Geological Society of America 1963 Annual Meeting, New York, Nov. 1963)
6	18-35755	ORINS. Gmelin, AED-CONF-63-264-6
CONF-502–		(International Congress of Nuclear Physics, Paris, July 1964)
17	18-36581	See UCRL-11379
CONF-537–		(USAEC-EURATOM Conference on Two Phase Flow Problems, Washington, D. C., Apr.–May 1964)
4	18-35686	See BNL-7998
CONF-551–		(Technical Meeting on the Use of Induced Mutations in Plant Breeding Programs, Rome, May–June 1964)
2	18-35309	See BNL-8010

Report No.	Abstract No.	Availability
CONF-553–	**(American Ceramic Society 66th Annual Meeting Including Symposium on Nuclear and Space Applications, Chicago, Apr. 1964)**	
6	18-36037	ORINS. Gmelin, AED-CONF-64-048-8
CONF-561–	**(Symposium on Inhaled Radioactive Particles and Gases, Richland, Wash., May 1964)**	
3	18-35800	ORINS. Gmelin, AED-CONF-64-049-5
CONF-618–	**(IBM Aerospace Data Utilization Workshop Meeting, Los Angeles, Apr. 1964)**	
1	18-36890	See SCL-R-64-68
CONF-620–	**(Institute of Nuclear Materials Management 5th Annual Meeting, Pittsburgh, May 1964)**	
1	18-35801	ORINS. Gmelin, AED-CONF-64-056-4
CONF-624–	**(Symposium on Nuclear Applications to the Wood, Paper, and Pulp Industries, Pullman, Wash., Apr. 1964)**	
1	18-35914	ORINS. Gmelin, AED-CONF-64-046-2
CONF-627–	**(European-American Committee on Reactor Physics, Hank, Norway, June 1964)**	
1	18-36774	Dep.(mc); $2.60(fs), $0.89(mf) OTS
CONF-638–	**(National Physical Laboratory Conference on Thermal Conductivity, Teddington, England, July 1964)**	
1	18-36888	See ORNL-P-149
2	18-35991	See ORNL-P-150
3	18-35990	See ORNL-P-148
CONF-639–	**(24th Annual Meeting of the Institute of Food Technologists, Washington, D. C., May 1964)**	
1	18-36877	$1.60(fs), $0.80(mf) OTS
2	18-36878	$1.60(fs), $0.80(mf) OTS
CONF-640–	**(24th Annual Meeting of the American Society for Microbiology, Washington, D. C., May 1964)**	
1	18-36879	Dep.(mc); $1.60(fs), $0.80(mf) OTS
CONF-641–	**(16th Annual Research Conference of the American Meat Institute Foundation, Chicago, Feb. 1964)**	
1	18-36880	Dep.(mc); $1.60(fs), $0.80(mf) OTS
CONF-642–	**(Health Physics Society, Cincinnati, June 1964)**	
1	18-35765	See ORNL-P-199
COO–		
774-4	18-35687	Dep.(mc); $1.10(fs), $0.80(mf) OTS
1148-86	18-36881	Dep.(mc); $2.60(fs), $0.92(mf) OTS
CRC–	**(Canadian)**	
1101	18-35836	Dep.; $1.00(AECL)
CRIO–	**(Canadian)**	
1194	18-36855	Dep.; $0.50(AECL)
CRRP–	**(Canadian)**	
1186	18-36568	Dep.; $2.00(AECL)
1197	18-36775	Dep.; $1.50(AECL)
1198	18-36776	Dep.; $0.50(AECL)
CVNA–	**(Misc.)**	
209	18-36803	Dep.(mc); $2.60(fs), $1.10(mf) OTS
DASA–	**(Misc.)**	
1307	18-35715	$3.60(OTS)
DL–	**(Canadian)**	
58	18-36804	Dep.; $0.50(AECL)
DP–		
869	18-35806	Dep.; $0.50(OTS)
872	18-35639	Dep.; $0.50(OTS)
873	18-36777	Dep.; $0.50(OTS)
911	18-35954	Dep.; $0.50(OTS)
EFINS–	**(Misc.)**	
64-19	18-36316	Phys. Rev., 135: B1203-4(1964)
ER–	**(Misc.)**	
1399-3	18-35979	See AD-437255
ERR-FW–	**(Non-AEC)**	
049A	18-35986	$7.60(OTS)
EU-B–	**(German)**	
29	18-36050	For translation see EURAEC-1006
EURAEC–		
1006	18-36050	Dep.(mc); $3.60(fs), $1.28(mf) OTS
1019	18-35987	Dep.(mc); $6.60(fs), $2.18(mf) OTS
1023	18-35973	Dep.(mc); $7.60(fs), $2.42(mf) OTS
1077(Suppl.)	18-36796	Dep.(mc); $1.10(fs), $0.80(mf) OTS
1100	18-36045	Dep.(mc); $2.60(fs), $1.01(mf) OTS
1133	18-35497	See GNEC-354
1154	18-36044	See CEND-3336-218
1156	18-35970	See NCSC-2663-17
1167	18-36757	See ACNP-64584
1170	18-36048	See SWRI-1243-14
FTD-TT–	**(Non-AEC)**	
64-619	18-36082	OTS
GA–	**(Misc.)**	
4769(Pt.I)	18-35929	
5373	18-36551	Dep.(mc); $1.60(fs), $0.80(mf) OTS
5495	18-36046	Dep.(mc); $1.10(fs), $0.80(mf) OTS
GEAP–	**(Misc.)**	
4615(Pt.II)	18-35688	Dep.(mc); $3.60(fs), $1.31(mf) OTS
GEMP–	**(Misc.)**	
83	18-35807	Dep.; $0.50(OTS)
GEST–	**(Misc.)**	
2033	18-36228	
GNEC–		
354	18-35497	Dep.(mc); $5.60(fs), $1.76(mf) OTS
HN–		
148	18-36835	Dep.(mc); $16.50(fs), $7.88(mf) OTS
HW–		
58563	18-35677	Dep.(mc); $1.60(fs), $0.80(mf) OTS
67245(Rev.)	18-35760	Dep.(mc); $2.60(fs), $1.04(mf) OTS
68600-40	18-35930	Dep.; $0.50(OTS)
73641	18-35654	$1.60(fs), $0.80(mf) OTS
75782	18-36752	Dep.(mc); $1.60(fs), $0.80(mf) OTS
75976	18-35498	Dep.(mc); $1.60(fs), $0.80(mf) OTS
76885	18-36758	Dep.(mc); $1.10(fs), $0.80(mf) OTS
77694	18-35444	Dep.(mc); $1.10(fs), $0.80(mf) OTS
79279	18-35761	Dep.(mc); $1.10(fs), $0.80(mf) OTS
80521	18-36753	Dep.; $0.50(OTS)
80970(Rev.1)	18-35689	Dep.; $1.75(OTS)
81600	18-35931	Dep.; $2.00(OTS)
81659	18-36778	Dep.; $1.25(OTS)
81956	18-35699	Dep.; $1.25(OTS)
81986	18-35837	Dep.; $0.75(OTS)
82009	18-35808	Dep.; $0.50(OTS)
82102	18-36047	Dep.; $0.75(OTS)
HW-SA–		
3170	18-36882	Dep.(mc); $1.10(fs), $0.80(mf) OTS
3190	18-35921	Dep.(mc); $2.60(fs), $0.92(mf) OTS
3193	18-36883	Dep.(mc); $1.10(fs), $0.80(mf) OTS
3265	18-35861	J. Appl. Phys., 35: 2636-8(1964)
IA–	**(Non-AEC)**	
888	18-35716	Dep.(mc)
IDO–		
14627	18-36856	Dep.; $2.75(OTS)
16996	18-36784	Dep.; $1.25(OTS)
IITRI–	**(Misc.)**	
C6007-12	18-36837	Dep.(mc); $5.60(fs), $2.00(mf) OTS
528-20	18-35655	Dep.; $1.50(OTS)
578P21-6	18-36759	Dep.; $2.00(OTS)

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INSJ–	**(Japanese)**	
66	18-36569	Dep.(mc)
73	18-36570	Dep.(mc)
74	18-36571	Dep.(mc)
75	18-36572	Dep.(mc)
76	18-36573	Dep.(mc)
IPPJ–	**(Japanese)**	
25	18-36713	Dep.(mc)
IS–		
812	18-35499	Dep.; $1.25(OTS)
817	18-35656	Dep.; $2.50(OTS)
849	18-35640	Dep.; $1.00(OTS)
JPRS–	**(Non-AEC)**	
25130	18-35324	$0.50(OTS)
25464	18-35269	$1.25(OTS)
25630	18-35327	$1.00(OTS)
25633	18-35384	$1.00(OTS)
25703	18-35385	$1.00(OTS)
K–		
1524	18-35445	Dep.; $0.50(OTS)
KFK–	**(German)**	
179	18-35373	Therapie Monats, 13: 102-15(1963)
223	18-36754	Dep.(mc)
KFKI–	**(Hungarian)**	
1491-F	18-36574	Dep.(mc) Nucl. Phys., 59: 364-74(1964)
KN–	**(Non-AEC)**	
63-76(R)	18-36750	
LA–		
2104	18-35964	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2113	18-35965	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2297	18-35966	Dep.(mc); $3.60(fs), $1.25(mf) OTS
2696	18-36884	Dep.; $0.50(OTS)
2859	18-35446	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2929	18-35657	Dep.; $2.75(OTS)
2997	18-35500	Dep.; $1.00(OTS)
3082	18-36552	Dep.; $0.50(OTS)
3091	18-35447	Dep.; $0.50(OTS)
3103	18-35448	Dep.; $0.50(OTS)
LADC–		
5830	18-35449	Dep.(mc); $1.60(fs), $0.80(mf) OTS
5995	18-36885	Dep.(mc); $7.60(fs), $2.45(mf) OTS
5996	18-35275	Dep.(mc); $1.60(fs), $0.80(mf) OTS
6010	18-36312	Phys. Rev., 135: B1119-27(1964)
6367	18-36431	Phys. Rev., 135: A1471-80(1964)
6403	18-35419	See TID-7678(p.319-57)
LAMS–		
1969	18-36221	Dep.(mc); $2.60(fs), $0.83(mf) OTS
3081	18-35658	Dep.; $1.00(OTS)
3104	18-35588	Dep.; $12.00(fs), $5.15(mf) OTS
3107	18-36793	Dep.; $0.50(OTS)
3112	18-36850	Dep.; $0.50(OTS)
LF–		
14	18-35838	Dep.; $0.50(OTS)
MATT–		
250	18-36714	Dep.(mc); $1.10(fs), $0.80(mf) OTS
MIT–	**(Misc.)**	
2098-60	18-36124	Dep.(mc); $1.10(fs), $0.80(mf) OTS
ML-TDR–	**(Non-AEC)**	
64-56	18-35933	OTS
64-125(Vol.I)	18-35934	OTS
64-175	18-35967	OTS
MLM-CF–	**(Misc.)**	
64-8-1	18-35935	Dep.(mc); $1.60(fs), $0.80(mf) OTS
MSAR–	**(Misc.)**	
60-34	18-35955	Dep.(mn); $1.00(cy), 1(mn) OTS
64-81	18-35988	Dep.(mc); $8.60(fs), $3.08(mf) OTS
64-93	18-35956	Dep.(mc); $1.60(fs), $0.80(mf) OTS
NAA-SR–		
7502	18-35957	Dep.; $1.50(OTS)
8399	18-36838	Dep.; $2.00(OTS)
9033	18-36805	Dep.; $2.00(OTS)
9430	18-36806	Dep.; $0.75(OTS)
9473	18-36807	Dep.; $2.50(OTS)
9479	18-36839	Dep.; $1.25(OTS)
9508	18-35936	Dep.; $2.00(OTS)
9511	18-36760	Dep.; $0.50(OTS)
9672	18-35501	Dep.; $1.00(OTS)
9723	18-36840	Dep.; $0.75(OTS)
9744	18-36553	Dep.; $0.50(OTS)
9748	18-35839	Dep.; $1.75(OTS)
9796	18-35937	Dep.; $0.75(OTS)
9803	18-36554	Dep.; $1.00(OTS)
9820	18-36841	Dep.; $2.00(OTS)
9848	18-36886	Dep.; $1.00(OTS)
9899	18-36842	Dep.; $0.75(OTS)
9988	18-35968	Dep.; $2.00(OTS)
NAA-SR-Memo–		
8162(Rev.)	18-35700	Dep.(mc); $1.10(fs), $0.80(mf) OTS
9411	18-35969	Dep.(mc); $3.60(fs), $1.37(mf) OTS
NASA-SP–	**(Misc.)**	
7011	18-35261	$2.00(OTS)
NASA-TN–	**(Misc.)**	
D-2404	18-36179	$0.50(OTS)
D-2408	18-36154	$0.50(OTS)
D-2429	18-36229	$1.00(OTS)
D-2452	18-35589	$0.50(OTS)
NAVDOCKS-MO–	**(Non-AEC)**	
218	18-35762	
NAVWEPS–	**(Non-AEC)**	
8132	18-36715	$1.60(OTS)
NCSC–	**(Misc.)**	
2477-2	18-35907	Dep.(mc); $6.60(fs), $2.06(mf) OTS
2663-17	18-35970	Dep.(mc); $1.60(fs), $0.80(mf) OTS
NMI–	**(Misc.)**	
2129	18-35938	Dep.(mc); $6.60(fs), $2.30(mf) OTS
NOTS-TP–	**(Non-AEC)**	
3224	18-36715	See NAVWEPS-8132
NP–	**(AEC File No. for Non-AEC Reports)**	
14043	18-35310	
14084	18-36575	Dep.(mc)
14101	18-36230	
14108	18-35702	
14161	18-35763	
14167	18-36576	Dep.(mc)
14174(Vol.2)	18-36887	Dep.(mc)
14177	18-35971	Dep.(mc)
14182	18-35590	Dep.(mc)
14188	18-35311	
14192	18-35939	
14193	18-35972	
14196	18-35312	
14198	18-35313	
14202	18-36577	Dep.(mc)
14203	18-36250	Dep.(mc)
14204	18-36794	Dep.(mc)
14207	18-35764	
14209	18-36716	
14210	18-35395	
NP-tr–	**(AEC File No. for Non-AEC Translations)**	
1161	18-35777	Dep.(mc); $3.60(fs), $1.22(mf) JCL
NSL–	**(Non-AEC)**	

Report No.	Abstract No.	Availability
62-113-10(Pt.II)	18-36717	$14.00(OTS)
NYO–		
1807-11	18-36671	Phys. Rev., 135: B1323-37(1964)
2404-4	18-35690	Dep.(mc); $5.60(fs), $1.82(mf) OTS
2911-1	18-35502	Dep.(mc); $4.60(fs), $1.64(mf) OTS
10559	18-35809	Dep.(mc); $1.60(fs), $0.80(mf) OTS
10610	18-35810	Dep.(mc); $1.10(fs), $0.80(mf) OTS
ORNL–		
3113(Rev.)	18-36718	Dep.; $4.00(OTS)
3487	18-36555	Dep.; $1.25(OTS)
3594	18-35503	Dep.; $1.00(OTS)
3610	18-36578	Dep.; $2.25(OTS)
3648	18-35659	Dep.; $1.75(OTS)
3656	18-35678	Dep.(mc); $10.10(fs), $3.83(mf) OTS
3661	18-35989	Dep.; $1.75(OTS)
3662	18-35940	Dep.; $1.00(OTS)
ORNL-P–		
25	18-36422	Nature, 203: 288-9(1964)
148	18-35990	Dep.(mc); $4.60(fs), $1.61(mf) OTS
149	18-36888	Dep.(mc); $1.60(fs), $0.80(mf) OTS
150	18-35991	Dep.(mc); $1.10(fs), $0.80(mf) OTS
199	18-35765	Dep.(mc); $3.60(fs), $1.40(mf) OTS
ORNL-RMIC–	**(Oak Ridge National Lab.)**	
2	18-35941	Dep.; Free(ORNL)
ORNL-TM–		
785	18-35641	Dep.(mc); $3.60(fs), $1.22(mf) OTS
798	18-35642	Dep.(mc); $6.60(fs), $2.03(mf) OTS
823	18-35643	Dep.(mc); $6.60(fs), $2.18(mf) OTS
836	18-35644	Dep.(mc); $2.60(fs), $1.10(mf)
888	18-35701	Dep.(mc); $1.60(fs), $0.80(mf) OTS
902	18-36836	Dep.(mc); $4.60(fs), $1.61(mf) OTS
922	18-35450	Dep.(mc); $1.10(fs), $0.80(mf) OTS
923	18-35766	Dep.(mc); $1.10(fs), $0.80(mf) OTS
ORNL-tr–		
188	18-35850	Dep.(mc); $1.60(fs), $0.80(mf) JCL
265	18-35915	Dep.(mc); $1.10(fs), $0.80(mf) JCL
280	18-35511	Dep.(mc); $1.60(fs), $0.80(mf) JCL
OTS–	**(Misc.)**	
64-31508	18-35324	See JPRS-25130
PAN–	**(Polish)**	
332	18-36579	Dep.
475/VII	18-36251	Dep.
494/IX	18-36808	Dep.
PATENTS	**(British)**	**3s. 6d. each, U. K. Patent Office**
964,948	18-36076	
965,014	18-36761	
965,020	18-35823	
965,097	18-35898	
965,104	18-36762	
965,147	18-35698	
965,209	18-36763	
965,227	18-35899	
965,334	18-35900	
965,403	18-36764	
965,533	18-36765	
965,534	18-36766	
PATENTS	**(Dutch)**	
103,433	18-35915	For translation see ORNL-tr-265
PATENTS	**(German)**	
1,169,043	18-36767	
1,169,044	18-36768	
1,169,430	18-35582	
1,169,596	18-36769	
1,169,598	18-36770	
1,169,907	18-35583	
1,169,908	18-35653	
1,170,083	18-36771	
1,170,084	18-36772	

Report No.	Abstract No.	Availability
PATENTS	**(U. S.)**	**$0.25 each, U. S. Patent Office**
3,142,533	18-35976	
3,142,624	18-36829	
3,142,625	18-36830	
3,142,626	18-36831	
3,142,627	18-36798	
3,142,648	18-36862	
3,142,752	18-35824	
3,142,754	18-35665	
3,142,756	18-35825	
3,142,757	18-35826	
3,142,759	18-35666	
3,142,979	18-35827	
3,145,098	18-35951	
3,145,148	18-36773	
3,145,149	18-36832	
3,145,150	18-36799	
3,145,152	18-36800	
3,145,181	18-36109	
3,145,184	18-35977	
3,145,300	18-35901	
3,145,336	18-35828	
PG–	**(Non-AEC)**	
80-7	18-35702	See NP-14108
PG-Report–	**(British)**	
390	18-35451	Dep.; $0.60(BIS), 3s. (HMSO)
572	18-35452	Dep.; $0.20(BIS), 1s. 2d. (HMSO)
573	18-35453	Dep.; $0.30(BIS); 1s. 9d. (HMSO)
579	18-35454	Dep.; $0.30(BIS); 1s. 9d. (HMSO)
PIBMRI–	**(Non-AEC)**	
1202-63	18-36719	$3.60(OTS)
PUC–		
1964-141	18-36659	Phys. Rev., 135: B1168-79(1964)
Q–	**(Misc.)**	
A2392-3-13	18-35679	See TID-20976
R–	**(Misc.)**	
64SD-10	18-35840	$3.60(OTS)
RADC-TDR–	**(Misc.)**	
63-275	18-36720	$9.60(OTS)
RCC-R–	**(British)**	
175	18-35591	Dep.; $0.90(BIS); 4s. 6d. (HMSO)
RISÖ–	**(Danish)**	
80	18-35811	Dep.(mc)
RLE-TR–	**(Non-AEC)**	
421	18-36079	OTS
RM–	**(Misc.)**	
4134	18-36070	
RPI–	**(Misc.)**	
328-8	18-36080	Dep.(mc); $9.10(fs), $3.44(mf) OTS
RTD-TDR–	**(Non-AEC)**	
63-3012	18-35317	$1.60(OTS)
63-3041(Vol.III)	18-35660	$9.60(OTS)
63-3125	18-35667	$6.60(OTS)
63-3130	18-36721	OTS
SB–	**(Non-AEC)**	
63-16	18-35981	See AD-439445
SC-DC–		
64-458	18-36837	See IITRI-C6007-12
64-1097	18-35645	Dep.(mc); $1.60(fs), $0.80(mf) OTS
SC-DR–		
64-978	18-36889	Dep.; $0.50(OTS)
SC-R–		
64-127	18-35767	Dep.; $1.00(OTS)

Report No.	Abstract No.	Availability
SC-RR–		
64-546	18-35922	Dep.; $1.60(fs), $0.80(mf) OTS
64-552	18-35505	Dep.; $0.50(OTS)
64-968	18-36843	Dep.; $0.75(OTS)
SCC–		
19	18-36049	See TID-20931
SCL-R–		
64-68	18-36890	Dep.; $0.75(OTS)
SLAC–		
28	18-36111	Dep.; $2.00(OTS)
SLAC-PUB–		
27	18-36321	Phys. Rev., 135: B1249-54(1964)
SRd–	**(Non-AEC)**	
63-5	18-36425	$9.60(OTS)
SRIA–		
126	18-35958	Dep.(mc); $1.60(fs), $0.80(mf) OTS
SRO–		
105	18-36809	Dep.(mc); $1.10(fs), $0.80(mf) OTS
SSD-TDR–	**(Non-AEC)**	
64-115	18-36722	OTS
SWRI–		
1243-14	18-36048	Dep.(mc); $12.50(fs), $5.57(mf) OTS
TDR–	**(Non-AEC)**	
269(4280-30)-2	18-36722	See SSD-TDR-64-115
TEI–		
849	18-35704	Dep.(mc); $2.60(fs), $0.95(mf) OTS
TID–		
3311(Suppl.1)	18-36857	Dep.; $2.75(OTS)
3312(Suppl.1)	18-35646	Dep.; $3.00(OTS)
3313	18-36810	Dep.; $3.00(OTS)
3724	18-36891	Dep.; Free(DTI Extension)
3910(Suppl.2)	18-35273	Dep.; $2.50(OTS)
3912(Index)	18-35318	Dep.; $0.50(OTS)
4100(Suppl.23)	18-35661	Dep.; Free(DTI Extension)
6613(Suppl.5)	18-35902	Dep.; $2.50(OTS)
7678	18-35408	Dep.; $4.50(OTS)
7695	18-35668	Dep.; $4.50(OTS)
19416	18-35770	Dep.(mc); $2.60(fs), $1.07(mf) OTS
19531	18-35320	Dep.(mc); $1.60(fs), $0.80(mf) OTS
19539	18-36896	Dep.(mc); $1.10(fs), $0.80(mf) OTS
19540	18-36252	Dep.(mc); $1.60(fs), $0.80(mf) OTS
20039	18-36833	Dep.; $1.00(OTS)
20149	18-36269	Nuovo Cimento (10), 33: 70-93(1964)
20414	18-35608	J. Am. Chem. Soc., 86: 3177-8(1964)
20416	18-35540	J. Inorg. Nucl. Chem., 26: 1465-7(1964)
20422	18-35841	Dep.(mc); $1.60(fs), $0.80(mf) OTS
20423	18-35842	Dep.(mc); $1.60(fs), $0.83(mf) OTS
20424	18-35843	Dep.(mc); $3.60(fs), $1.34(mf) OTS
20425	18-35844	Dep.(mc); $2.60(fs), $1.04(mf) OTS
20426	18-36844	Dep.; $0.50(OTS)
20508	18-35903	Dep.; $1.00(OTS)
20521	18-35367	Radiation Res., 22: 682-92(1964)
20536	18-35610	J. Phys. Chem., 68: 2040-3(1964)
20539	18-36338	Phys. Rev., 135: B1483-6(1964)
20566	18-36330	Phys. Rev., 135: B1398-1427(1964)
20567	18-36270	Nuovo Cimento (10), 33: 94-109(1964)
20730	18-36657	Phys. Rev., 135: B1152-60(1964)
20873	18-36155	Dep.(mc); $1.60(fs), $0.80(mf) OTS
20878	18-35992	Dep.(mc); $1.60(fs), $0.80(mf) OTS
20887	18-36897	Dep.(mc); $1.10(fs), $0.80(mf) OTS
20892	18-36723	Dep.(mc); $2.60(fs), $0.86(mf) OTS
20895	18-35845	Dep.(mc); $4.60(fs), $1.61(mf) OTS
20896	18-35846	Dep.(mc); $1.60(fs), $0.80(mf) OTS
20914	18-35262	Dep.(mc); $1.60(fs), $0.83(mf) OTS
20915	18-35281	Dep.(mc); $1.60(fs), $0.80(mf) OTS
20916	18-35426	Dep.(mc); $2.60(fs), $0.86(mf) OTS
20917	18-35847	Dep.(mc); $4.60(fs), $1.67(mf) OTS
20918	18-35848	Dep.(mc); $3.60(fs), $1.22(mf) OTS
20931	18-36049	Dep.(mc); $3.60(fs), $1.13(mf) OTS
20935	18-36558	Dep.(mc); $9.10(fs), $3.26(mf) OTS
20936	18-35663	Dep.(mc); $1.60(fs), $0.80(mf) OTS
20937	18-35321	Dep.(mc); $1.60(fs), $0.80(mf) OTS
20941	18-35322	Dep.(mc); $4.60(fs), $1.61(mf) OTS
20948	18-35592	Dep.(mc); $4.60(fs), $1.61(mf) OTS
20976	18-35679	Dep.(mc); $1.60(fs), $0.80(mf) OTS
21013	18-35323	Dep.(mc); $1.60(fs), $0.80(mf) OTS
TN–	**(Non-AEC)**	
567	18-36749	See AD-431671
TO-B–	**(Non-AEC)**	
63-40	18-35849	$3.60(OTS)
63-76	18-35771	$8.10(OTS)
TRG-Report–	**(British)**	
83	18-36785	Dep.; $0.30(BIS); 1s. 6d. (HMSO)
TT–	**(Canadian)**	
64-31736	18-35269	See JPRS-25464
64-31902	18-35327	See JPRS-25630
64-31905	18-35384	See JPRS-25633
64-31975	18-35385	See JPRS-25703
UCLA–		
12-529	18-35263	Dep.(mc); $7.60(fs), $2.42(mf) OTS
UCRL–		
7186	18-36898	Dep.(mc); $1.60(fs), $0.80(mf) OTS
7384	18-35506	Dep.(mc); $1.60(fs), $0.80(mf) OTS
7425	18-36253	Dep.(mc); $2.60(fs), $0.95(mf) OTS
7506	18-36580	Dep.(mc); $1.10(fs), $0.80(mf) OTS
7636	18-35865	Nucl. Instr. Methods, 29: 1-24(1964)
7811	18-35773	Dep.; $1.25(OTS)
7827	18-36786	Dep.; $1.75(OTS)
7864	18-36724	Dep.; $1.00(OTS)
10468(Rev.)	18-35993	Dep.(mc); $4.60(fs), $1.55(mf) OTS
10768	18-36899	Dep.(mc); $8.10(fs), $2.63(mf) OTS
10791	18-36900	Dep.(mc); $2.60(fs), $0.98(mf) OTS
10899	18-35994	Dep.(mc); $7.60(fs), $2.51(mf) OTS
10957	18-36901	Dep.(mc); $1.10(fs), $0.80(mf) OTS
10969	18-36902	Dep.(mc); $1.60(fs), $0.80(mf) OTS
10995	18-36903	Dep.(mc); $5.60(fs), $1.76(mf) OTS
11019	18-36904	Dep.(mc); $1.60(fs), $0.80(mf) OTS
11089	18-36112	Dep.(mc); $3.60(fs), $1.25(mf) OTS
11090	18-36113	Dep.(mc); $5.60(fs), $1.73(mf) OTS
11148	18-36592	J. Inorg. Nucl. Chem., 26: 1341-7(1964)
11224	18-36664	Phys. Rev., 135: B1295-1301(1964)
11291	18-36254	Dep.(mc); $11.50(fs), $4.91(mf) OTS
11345	18-36662	Phys. Rev., 135: B1281-7(1964)
11360	18-36255	Dep.(mc); $5.60(fs), $1.91(mf) OTS
11379	18-36581	Dep.(mc); $1.10(fs), $0.80(mf) OTS
13063	18-36905	Dep.(mc); $7.60(fs), $2.57(mf) OTS
13067	18-36906	Dep.(mc); $3.60(fs), $1.37(mf) OTS
13070	18-35507	Dep.(mc); $3.60(fs), $1.37(mf) OTS
UJV–	**(Czechoslovakian)**	
939/63	18-36114	Dep.(mc)
957/63	18-36787	Dep.(mc)
989/64	18-35995	Dep.(mc)
1008/63	18-36795	Dep.(mc)
1066/64	18-35508	Dep.(mc)
1075/64	18-35593	Dep.(mc)
1079/64	18-35509	Dep.(mc)
UR–		
656	18-35268	Dep.; $4.60(fs), $1.58(mf) OTS
875-29	18-36318	Phys. Rev., 135: B1211-14(1964)
USACDCNG–	**(Non-AEC)**	
62-5(Rev.)	18-35774	
USAELRDL-TR–		**(Non-AEC)**
2431	18-36231	$1.60(OTS)
2434	18-36232	$1.10(OTS)
USNRDL-TR–	**(Non-AEC)**	
763	18-35813	OTS

Report No.	Abstract No.	Availability
WAL-TR–	**(Non-AEC)**	
401/303-4	18-35944	$2.60(OTS)
WANL-PR–	**(Misc.)**	
(S)001-A	18-36811	$5.60(OTS)
WAPD-T–		
1681	18-36559	Dep.(mc); $1.60(fs), $0.80(mf) OTS
WAPD-TM–	**(Misc.)**	
348	18-35775	Dep.(mc); $2.60(fs), $0.92(mf) OTS
WCAP–	**(Misc.)**	
3374-1	18-35691	Dep.(mc); $7.60(fs), $2.36(mf) OTS
Y–		
1467	18-35510	Dep.; $0.50(OTS)

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